TIDAL WAVE Sp

NOVAMETRIX CAPNOGRAPHY/OXIMETRY

HANDHELD CAPNOGRAPH/OXIMETER

User's Manual

Model 710/715

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Declaration of Conformity with European Union Directives

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Section 1 General Description

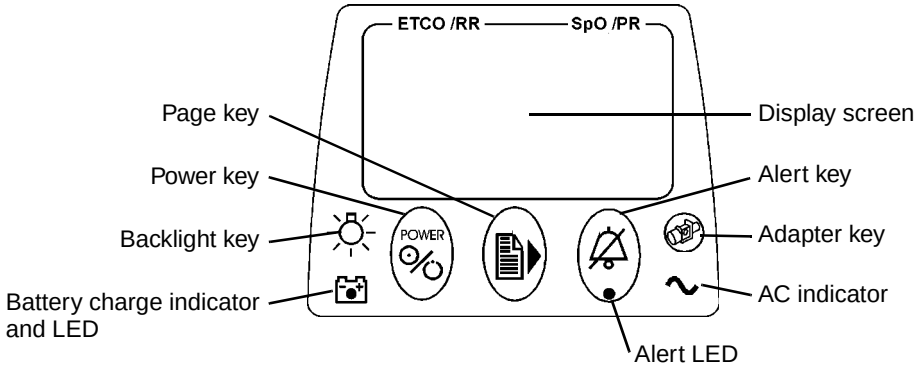
Indication for use

The Model 710 and Model 715 *TIDAL WAVE Sp* handheld, portable Capnometer/Oximeters are intended to be used for monitoring end tidal CO_2, respiration rate, functional oxygen saturation and pulse rate in monitoring environments such as ventilatory support, emergency and anesthesia. The Model 715 incorporates a miniature vacuum pump to draw expired respiratory gases through the CAPNOSTAT CO_2 Sensor using a sampling airway adapter and nasal cannula. *TIDAL WAVE Sp* is designed to monitor adult, pediatric and neonatal patients. *TIDAL WAVE Sp* is not intended for any other purpose.

NOTE

Components of this product and its associated accessories which have patient contact are free of latex.

Keypanel Controls and Indicators



Controls

Power Key

Switches power on/off. Press the POWER key to place the unit into operate mode (ON) or to turn the unit OFF. Refer to “AC/Battery Operation” on page 9.

With monitor ON, press and hold the POWER key to enter the MONITORING MODE selection menu. Refer to “Monitoring Mode” on page 41 for more information.

Page Key

Press to set display screen to Data Display, $EtCO_2$ waveform, plethysmogram, $EtCO_2$ trend, Respiration trend or SpO_2 trend.

Press and hold to enter the PRINT SELECTION menu. See "Printing" on page 54.

Alert Key

When pressed, will set the 2 minute silence (audible alerts muted for two minutes) and displays the SET ALERTS menu. If the SET ALERTS menu is not needed, it will automatically disappear after 3 seconds.

For 2 minute silence, the icon will illuminate for the duration. Press again to cancel.

Press and hold for 3 seconds to disable audible alerts, and the icon will flash. Press and hold again to cancel.

The Alert Key LED will display the following:

- Steady yellow: audio silenced for 2 min., no alert in progress.
- Flashing yellow: audio silenced (no alert in progress).
- Flashing red and yellow: alert in progress; audio is off or 2 minute silence.

Audible alerts may be permanently disabled from the Configuration menu. Refer to "Configuration Menus" on page 16 for more information.

Adapter Key

Press to set adapter type: adult, neonatal or sampling.

Press and hold for 4 seconds to zero an adapter. See "Adapter Zero Procedure" on page 22 for more information.

Press to cancel Auto Power Off function.

Backlight Key

Press to turn backlight on/off, or press and hold to adjust contrast for up/down viewing angles and for adjustment due to extreme temperature variations.

Indicators

Battery Alert Indicator

Illuminates when the unit is on battery power. Green; battery is fully charged, slow flashing yellow; battery power is low (approximately 20 minutes of operation remains), Fast flashing red; battery is exhausted (approximately 5 minutes of operation remains). The battery alert indicator is off when external power is connected. Refer to "AC/Battery Operation" on page 9 for information on connecting AC power and charging the battery.

AC Power Indicator

Illuminated green when the monitor is connected to an AC power source (e.g. the external power supply (PN 9220-10), or the BaseStation (PN 6998-00), while powered by the external power supply).

Icons

The icons listed below may appear on the display screen when the *TIDAL WAVE Sp* is in use.

Alert Silence Icon

Audible alerts silenced.

2-Minute Silence Icon

Audible alert silenced for two minutes.

Alert Limits Disabled Icon

Alert limits disabled. Select ENABLED or DISABLED in the CONFIGURATION menu.

Airway Adapter Icon

Indicates adapter key.

Time/Date Icon

Set time/date. Press ☼ from the CONFIGURATION menu to set time and date.

Backlight Icon

Indicates backlight key.

Trend Screen Icon

Displayed beside any Trend screen.

Temperature Icon

Sensor not up to temperature icon. Displayed when performing an adapter zero and the sensor is not at operating temperature.

Waveform Icon

CO_2 detected icon. Displayed when selecting an adapter zero and the monitor detects breaths.

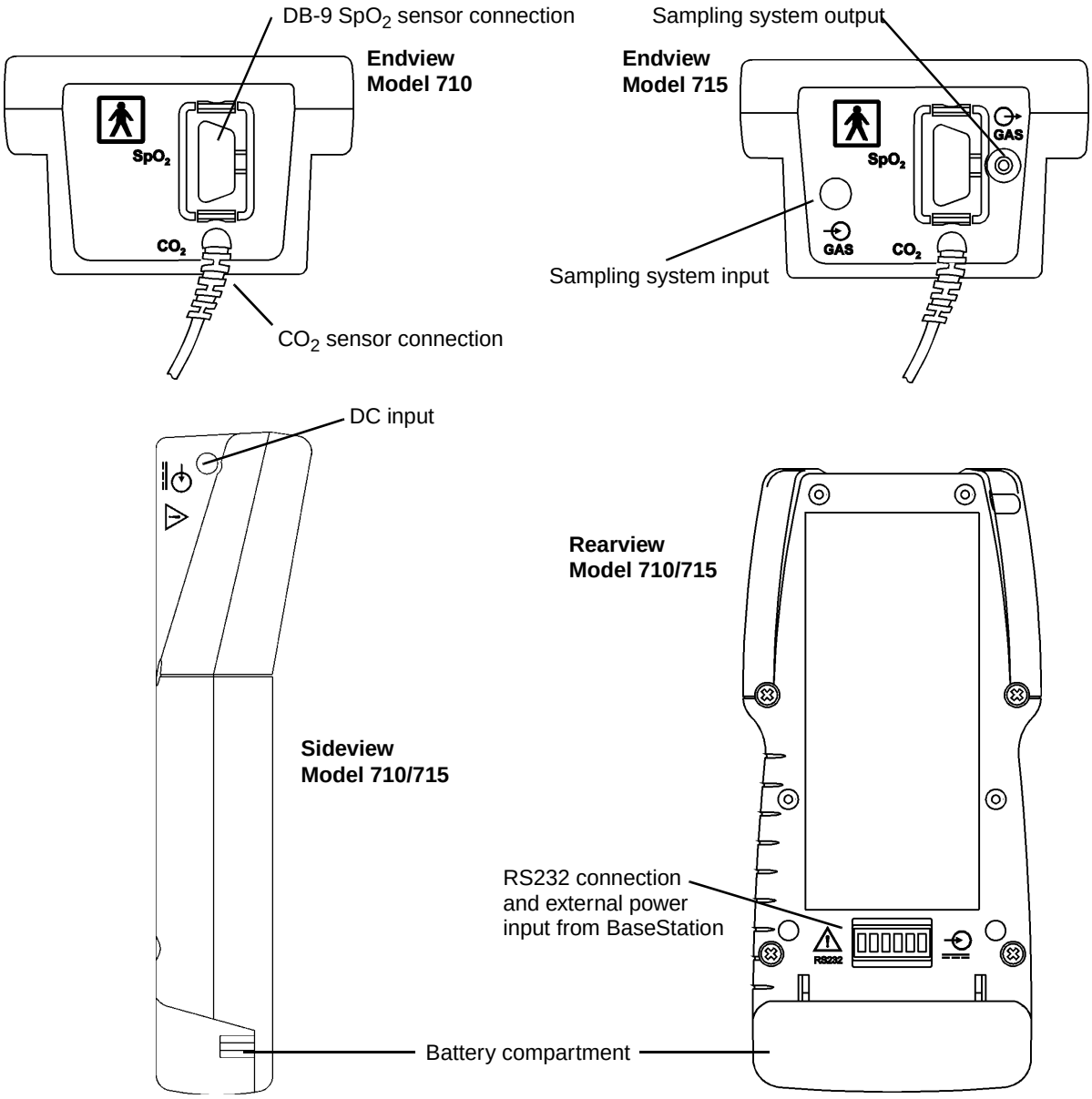
Heart Icon

Pulse detected icon. Displayed when SpO_2 sensor is attached to patient and the monitor detects a pulse.

Lung Icon

Breaths detected icon. Displayed when CAPNOSTAT CO_2 sensor is attached to patient and breaths are detected.

Connections and Labeling



Symbols

	Patient isolation: Identifies connection as type BF
	Attention: Consult manual for detailed information
	Sampling System: Gas output
	Sampling System: Gas input
	DC input. Connect external power supply to this port. Use only Novametrix external power supply, Catalogue number 9220-10.
	Recyclable item. This symbol is found on the internal battery and should not concern the common user. Refer to qualified service personnel when battery replacement is required.
	Separate collection. Appropriate steps must be taken to ensure that spent batteries are collected separately when disposed of. This symbol is found on the internal battery and should not concern the common user. Refer to qualified service personnel when battery replacement is required.

Principle of operation

CO_2

TIDAL WAVE Sp uses the CAPNOSTAT CO_2 sensor to measure CO_2 by using the infrared absorbtion technique, which has endured and evolved in the clinical setting for over two decades and remains the most popular and versatile technique today.

The principle is based on the fact that CO_2 molecules absorb infrared (IR) light energy of specific wavelengths, with the amount of energy absorbed being directly related to the CO_2 concentration. When an IR beam is passed through a gas sample containing CO_2, the electronic signal from the photodetector (which measures the remaining light energy) can be obtained. This signal is then compared to the energy of the IR source and calibrated to accurately reflect CO_2 concentration in the sample. To calibrate, the photodetector's response to a known concentration of CO_2 is stored at the factory in the monitor's memory. A reference channel accounts for optical changes in the sensor, allowing the system to remain in calibration without user intervention.

SpO_2

The *TIDAL WAVE Sp* determines oxygen saturation using sensors that contain red and infrared (660 and 940 nanometer) light sources, called light emitting diodes (LEDs). The light energy from each LED is beamed through a tissue sample—a pulsating vascular bed such as the patient's finger or toe. The remaining light energy not absorbed by the tissue sample reaches a photodiode light receptor in the sensor. Oxygen saturated blood absorbs

different amounts of light at each wavelength as compared to desaturated blood. Therefore, the amount of light absorbed by the blood in each pulse can be used to calculate oxygen saturation.

The *TIDAL WAVE Sp* is calibrated to display "functional" saturation. This differs from the "fractional" saturation value displayed by most co-oximeters. Functional saturation is defined as:

$$\text{Functional Saturation} = \frac{HbO_2}{100 - (COHb + METHb)}$$

HbO_2 = Fractional Oxyhemoglobin
COHb = Carboxyhemoglobin
METHb = Methemoglobin

This can be considered to represent the amount of oxyhemoglobin as a percentage of the hemoglobin that can be oxygenated. Dysfunctional hemoglobins (COHb and METHb) are not included in the measurement of functional saturation.

Pulse Rate is calculated by measuring the time interval between peaks of the infrared light waveform. The inverse of this measurement is displayed as pulse rate.

The oxygen saturation and pulse rate values are updated once each second. Presence of a pulse is indicated visibly by a plethysmogram graphic display and audibly by a "beep," when configured.

The *TIDAL WAVE Sp* must be used in conjunction with SuperBright™ Sensors. See "Accessories" on page 69 for a list of available sensors and accessories.

Section 2 *Safety*

For maximum patient and operator safety, you must follow the following warnings and cautions.

WARNINGS

Indicates a potentially harmful condition that can lead to personal injury.

- **Explosion Hazard:** *DO NOT* use *TIDAL WAVE Sp* in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- **Electrical Shock Hazard:** Always turn *TIDAL WAVE Sp* off and remove any external devices before cleaning it. Refer servicing to qualified service personnel.
- **Failure of Operation:** If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- Do not operate *TIDAL WAVE Sp* if it appears to have been dropped or damaged.
- Do not operate *TIDAL WAVE Sp* or its accessories when it is wet due to spills or condensation.
- Never sterilize or immerse the monitor, sensor or accessories in liquids.
- The monitor does not alert for NO RESPIRATION if the airway adapter is removed from the CAPNOSTAT CO_2 sensor.
- Verify the "No Resp Timer" setting prior to use.
- Do not position any sensor cable in a way that may cause entanglement or strangulation.
- The *TIDAL WAVE Sp* is not intended to be used as a primary diagnostic apnea monitor and/or recording device.
- Patient Safety: Care should be exercised to assure continued peripheral perfusion distal to the SpO_2 sensor site after application.
- Inspect the SpO_2 sensor site often for adequate circulation - at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.
- Data Validity: As with all pulse oximeters, inaccurate SpO_2 and Pulse Rate values may be caused by:
  - Incorrect application or use of sensor;
  - Significant levels of dysfunctional hemoglobin; carboxyhemoglobin or methemoglobin;
  - Significant levels of indocyanine green, methylene blue, or other intravascular dyes;
  - Exposure to excessive illumination such as surgical lamps-especially those with a xenon light source, or direct sunlight;
  - Excessive patient movement;
  - Venous pulsations;
  - Electrosurgical interference.
- The external battery charger should NOT be used to recharge the battery near or in close proximity to patients and/or other medical equipment in operation. It is intended for use in service areas only (i.e. nurses station, biomed lab, etc.).

- Connection of an external device (e.g. printer or computer) to the RS232 serial port on the BaseStation may compromise patient safety.

CAUTIONS

Indicates a condition that may lead to equipment damage or malfunction.

- Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.
- Use only an external power supply approved by Novametrix for use with this device. Use of any other power supply may damage the *TIDAL WAVE Sp* and void the warranty.
- Do not operate *TIDAL WAVE Sp* or its accessories when it is wet due to spills or condensation.
- Do not operate *TIDAL WAVE Sp* if it appears to have been dropped or damaged.
- Keep *TIDAL WAVE Sp* and its accessories clean.
- Inspect the integrity of the *TIDAL WAVE Sp* and its accessories prior to use.
- Never sterilize or immerse the monitor, sensor or accessories in liquids.
- Do not sterilize or immerse sensors except as directed in this manual.
- Do not apply excessive tension to any sensor cable or pneumatic tubing.
- Do not store the monitor or sensors at temperatures less than 14°F (-10°C) or above 131°F (55°C).
- Do not operate the monitor or sensors at temperatures below 50°F (10°C) or above 104°F (40°C).
- If a Single Patient Use Sampling Adapter becomes occluded, replace and discard the adapter.
- It is recommended that the CAPNOSTAT CO_2 sensor be removed from the circuit whenever an aerosolized medication is delivered. This is due to the increased viscosity of the medications which may contaminate the sensor windows, causing the sensor to fail prematurely.
- Where electromagnetic devices (i.e. electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electromagnetic fields up to 3V/m will not adversely affect system performance.
- Refer servicing to qualified personnel.

NOTES

Indicates points of particular interest or emphasis for more efficient or convenient operation.

- The *TIDAL WAVE Sp* monitor is intended for operation with Novametrix Single Patient Use airway adapters.
- Operating the *TIDAL WAVE Sp* below 50°F (10°C) will result in longer warm-up time and reduce battery life.
- Components of this product and its associated accessories which have patient contact are free of latex.
- Certain rebreathing circuits, or the presence of artifacts such as cardiogenic oscillations, may cause *TIDAL WAVE Sp* to react to non-respiratory CO_2 fluctuations as if they were breaths. This condition affects only the RESP numerical displays; the capnogram display continues to provide an accurate picture of the CO_2 waveform.
- After the life cycle of our equipment and all accessories has been met, disposal of the equipment should be accomplished following the national requirements. Contact the local Novametrix representative for questions concerning disposal.

Section 3 Preparation for Use

The *TIDAL WAVE Sp* can be powered four ways: from seven "AA" disposable lithium batteries, a rechargeable NiMH battery, the 9220-10 external power supply or the 6998-00 BaseStation combined with the external power supply, all available from Novametrix.

AC/Battery Operation

Press the POWER key to place the unit into operate mode (ON) or to turn the unit OFF. The status of the unit is dependent upon both the Power key and the power source.

The monitor can operate for up to 4.5 hours while powered from a fully charged internal battery (4 hours when using sampling pump, Model 715). The battery is charging when the monitor is powered through its DC input and the keypanel icon is green. The battery will charge even if the monitor is off. Power to the DC input is supplied by the external power supply (Cat. No. 9220-10) with or without the optional BaseStation (Cat. No. 6998-00).

Rechargeable and disposable battery capacity is shown in the table titled, "Battery Life and Recharge Times" on page 14. Times may be reduced in colder temperatures or with the sampling adapter; operation with the backlight off may slightly increase these times.

Battery Status and Alerts

When the monitor is operating on battery power, and the battery is sufficiently charged, the battery icon LED on the keypanel will be green. The battery level is reflected on the battery icon by different colors (for example, battery fully charged: green, battery low: flashing yellow).

The LED on the keypanel flashes red when the monitor is powered by its internal battery and approximately 5 minutes remain. The monitor will sound an audible alert, then when the battery is depleted, turn itself off. This alert can only be silenced by connecting the external supply or turning the monitor off. The NiMH battery pack should be replaced, or the *TIDAL WAVE Sp* BaseStation (Cat. No. 6998-00) or external power supply (Cat. No. 9220-10) should be connected to recharge the battery (rechargeable batteries only) and power the monitor. See "Battery Life and Recharge Times" on page 14.

NOTE

When the battery is low (red blinking battery LED on keypanel) the monitor has shut down CO_2 and SpO_2 functions. Connect to AC power as soon as possible.

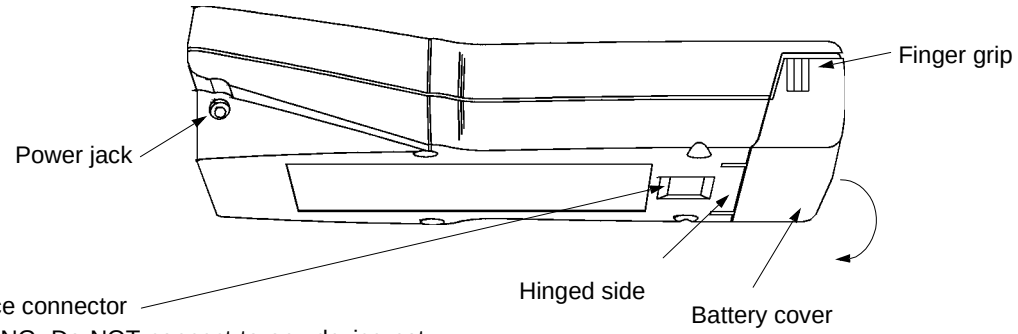
NOTE

- The battery life indicator may not reflect the true battery status upon power-up for approximately 30 seconds.
- The battery life indicator is inactive when the monitor is powered by the BaseStation or the external power supply.

Battery Use and Options

Removing and Installing the Battery

Grasp the finger grips on each end of the battery cover. Squeeze together and pull so that the cover opens to reveal the internal battery (the cover is hinged on the bottom of the case). Remove the battery from the monitor.



The battery is keyed so that it can be installed in only one way (see illustration inside battery compartment). The contacts should go in first and be located toward the top left of the monitor when inserting. Make certain the battery cover is properly closed before operating the monitor.

Rechargeable Batteries

The NiMH rechargeable battery pack (Cat. No. 400043) can be used to power the *TIDAL WAVE Sp* for approximately 4.5 hours of continuous operation (4 hours when using sampling pump, Model 715).

Optional
Rechargeable battery,
(NiMH 7.2 vdc)

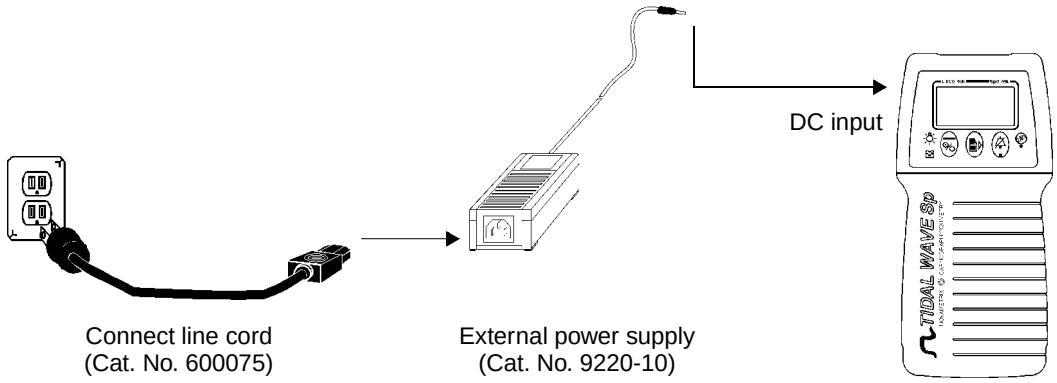
NOTE

- Refer to the instruction sheet packaged with the rechargeable battery for complete operating instructions.

To charge a rechargeable battery while in the monitor:

External Power Supply

Alternatively, plug the external power supply directly into the DC power jack on the side of the monitor, and connect a hospital-grade line cord to an AC source. The AC icon ∿ will illuminate green and the battery will charge in approximately 5.5 hours. If the monitor has been stored with the battery installed for thirty (30) days or more, charge the battery for 24 hours prior to use.



Connect line cord
(Cat. No. 600075)

External power supply
(Cat. No. 9220-10)

CAUTION

- Use only Novametrix supplied devices when connecting to the power input jacks on the *TIDAL WAVE Sp* or on the BaseStation.
- Do not attempt to use the adapter for the external battery charger for this function.

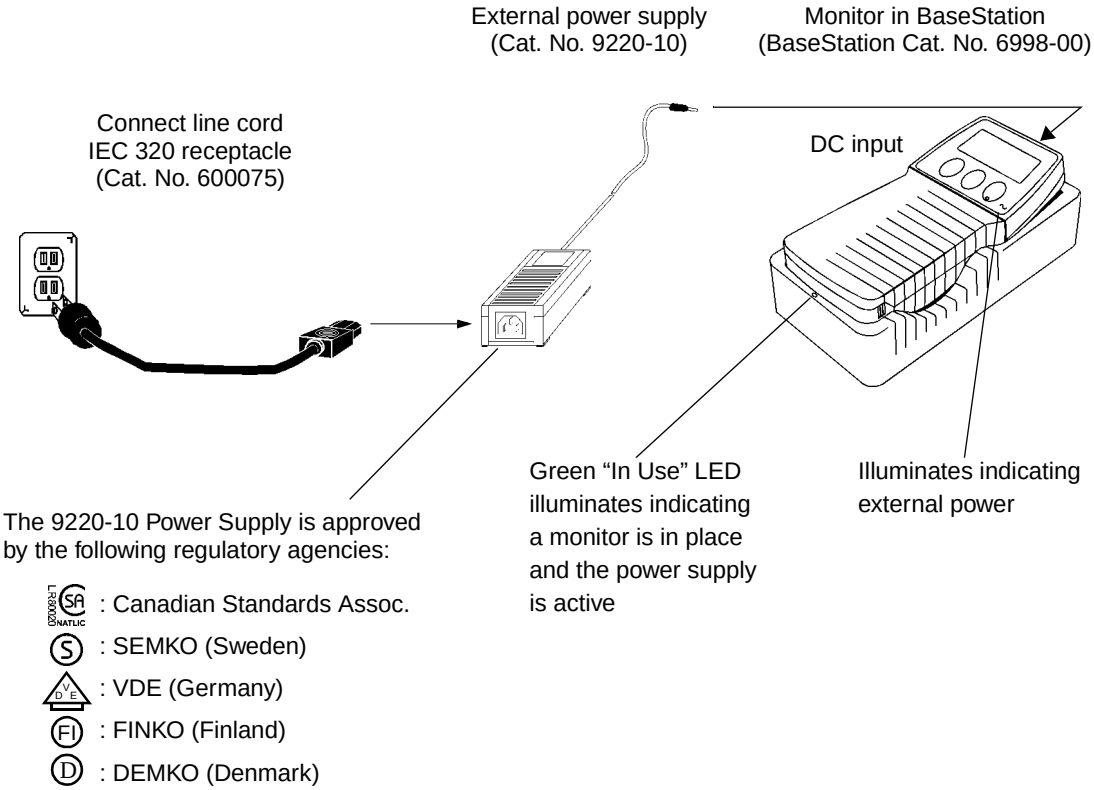
NOTE

- When powered by the external power supply, the *TIDAL WAVE Sp* will not overcharge a rechargeable battery.
- The external power supply has a universal power input. The IEC 320 input receptacle for line cord connection allows compatibility with every country's voltage and frequency requirements.

Optional BaseStation

Power for the BaseStation is supplied by an external power supply (PN 9220-10) or the internal battery. When the power supply is properly connected to the BaseStation and a monitor is placed within the station the green, "In Use" LED will illuminate. The ∿ icon on the monitor will also illuminate indicating that external power is connected.

Connect the external power supply jack to the monitor and connect a hospital-grade line cord from the external power supply to an AC source.

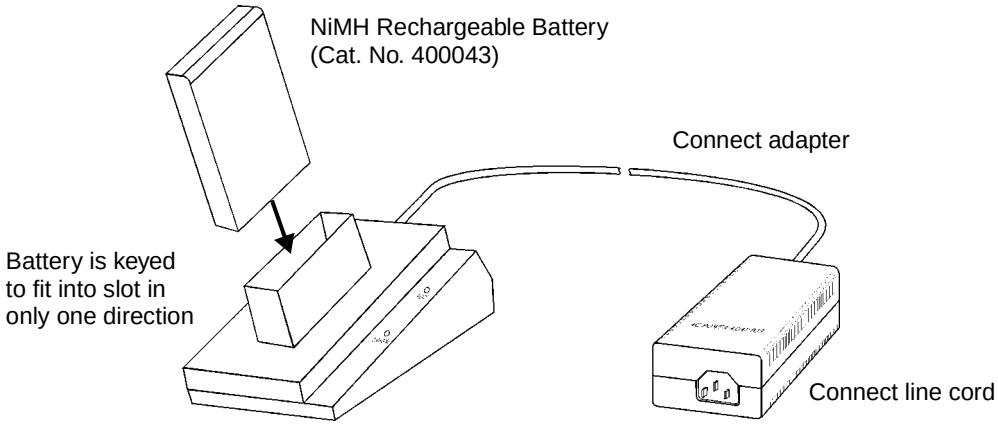


CAUTION

- Although other connectors may physically fit, do not attempt to connect any device other than power supplies approved by Novametrix for use with this device. Doing so may damage the *TIDAL WAVE Sp* and will void the warranty.
- Never sterilize or immerse the monitor, sensor or accessories in liquids.

Charging NiMH Rechargeable Battery with External Charger

In a non-patient area, connect the adapter to an AC source, then plug the adapter jack into the charger. Remove the battery from the *TIDAL WAVE Sp* and insert it into the external charger. The battery will be fully charged in approximately 4.5 hours. The external charger is for use with the NiMH rechargeable battery pack (Cat. No. 400043) only. Refer to the instructions supplied with the charger for additional information.



WARNING

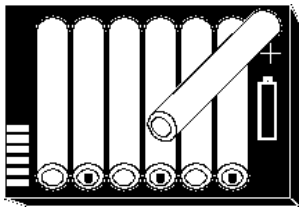
- The external battery charger should NOT be used to recharge the battery near or in close proximity to patients and/or other medical equipment in operation. It is intended for use in service areas only (i.e. nurses station, biomed lab, etc.).

NOTE

- With a new battery, or a battery that has not been used for 30 days or more, charge the battery for 24 hours prior to use.
- When powered by the external power supply or the BaseStation, the *TIDAL WAVE Sp* will not overcharge a rechargeable battery.
- The monitor may not operate on battery power if the battery is not sufficiently charged.
- Dispose of batteries in accordance with local laws.

AA Lithium Batteries

To power *TIDAL WAVE Sp* from AA lithium batteries, insert seven disposable batteries (Energizer L91 or equivalent) into the optional Battery Case (Cat. No. 6862-00) following the polarity markings on the Battery Case.



Standard
AA lithium batteries
(7 ea. - disposable)

WARNING

- Batteries can explode, leak or catch on fire if heated or exposed to fire or high temperatures.
- Do not mix battery types (e.g. disposable and rechargeable AA batteries).

Battery Life and Recharge Times

Configuring the monitor to turn off unused functions will result in longer battery life. The following table lists battery operation times with Sampling pump off (Model 710/715), Sampling pump on (Model 715) for each mode: CO_2/SpO_2, CO_2, or SpO_2. See “Monitoring Mode” on page 41.

Configuration	Power source - Approximate Monitoring Times	
	Rechargeable NiMH battery	AA lithium batteries
Model 710/715 - CO_2/SpO_2	4.5 hours	4.0 hours
Model 715 - CO_2 Sampling/SpO_2	4.0 hours	3.5 hours
Model 710/715 - CO_2 only	4.5 hours	4.0 hours
Model 715 - CO_2 Sampling only	4.0 hours	3.5 hours
Model 710/715 - SpO_2 only	7.0 hours	6.5 hours
Recharge Time: External charger w/adapter	4.5 hours	n/a
Recharge Time: External power supply or External power supply/BaseStation	5.5 hours (in monitor)	n/a

NOTE

Excessive alerting reduces battery life when operating on battery power.

Automatic Power Off Feature

The automatic power off feature is included to conserve battery power in the event of an unintentional power up of the monitor. This option will shut the monitor off if there is no CO_2 breath or pulse detection after 5 minutes from when the unit powers on, or after 20 minutes of no monitoring (no breath or pulse detected and no alert conditions). After the 5 or 20 minutes has elapsed, an AUTO POWER OFF IN X:XX message will appear on the screen and the timer (X:XX) will count down from one minute to zero. Pressing the adapter key, or detection of a CO_2 breath or pulse will cancel the shutdown, otherwise the unit will shut off.

Long Term Storage

If the monitor has not been used or powered by the external power supply for an extended time* (3 months or more) allow the battery to charge before use or replace the battery with a fully charged battery and continue monitoring. The monitor may not power up on battery power if the battery is not sufficiently charged. Refer to “Battery Life and Recharge Times” on page 14.

NOTE

- New batteries, or batteries stored for extended periods of time may need to be fully charged and discharged up to five (5) times before performing at full capacity.
- With a new battery, or a battery that has not been used for 30 days, charge the battery for 24 hours prior to use.

Serial Communications/Power Interface Connector

Located on the enclosure rear is a six pin modular contact which provides an RS232 interface as well as a power input for unit operation and battery charging when connected to Novametrix accessories. This connector meets the patient safety requirements of the following agencies: IEC 601-1, UL544.

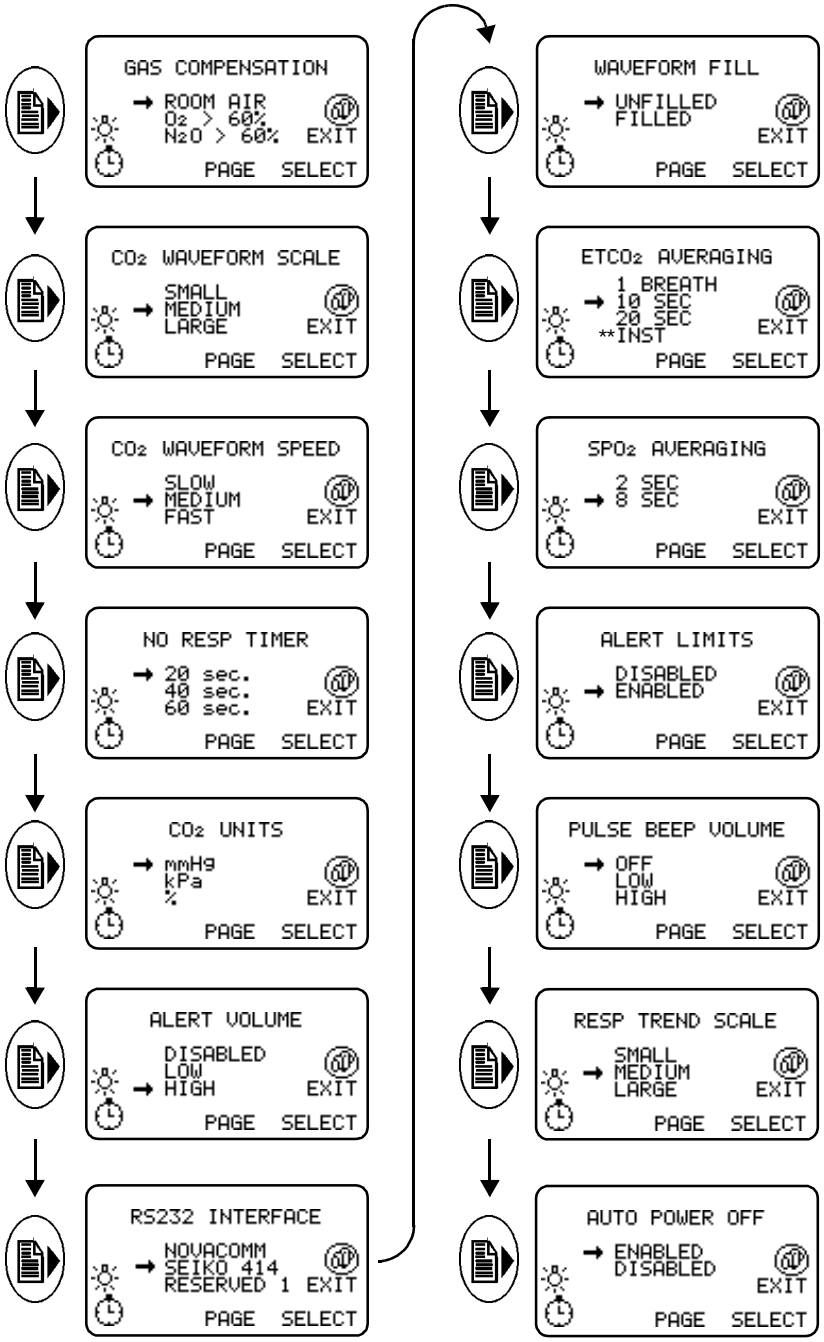
The BaseStation (Cat. No. 6998-00) is an optional accessory onto which Novametrix hand-held monitors can be placed, providing a platform for communication support between the monitor and a host computer or printer. The BaseStation is meant for table-top (horizontal), *not* pole-mounted (vertical) applications and can be used anywhere the *TIDAL WAVE Sp* monitor is used; including but not limited to the sleep lab, ICU, anesthesia, post anesthesia, emergency department, respiratory care, home care, and pre-hospital emergency.

The BaseStation provides RS232 serial communications as supported by the monitor, with or without the external power supply connected. In addition, the BaseStation is capable of providing power to charge a rechargeable battery inside the monitor when used with the external power supply.

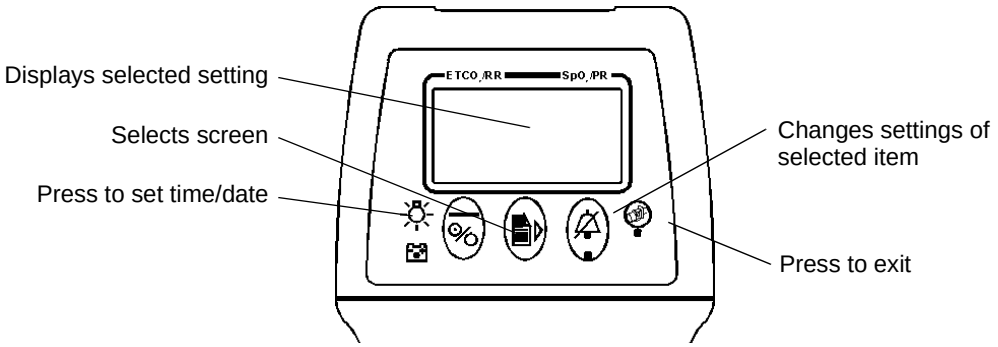
*The internal battery will slowly discharge over long periods of non-use.

Configuration Menus

CONFIGURATION menus are provided on the *TIDAL WAVE Sp* to allow customizing of various settings. To access the CONFIGURATION menus, press and hold the key, then simultaneously press the key until the first CONFIGURATION menu is displayed. Press the PAGE key to move through the menus. The SELECT key moves the arrow pointer; the parameter chosen will flash. Press the EXIT key at any time to return to monitoring mode (selections will be saved).



**Press SELECT to scroll down to INST in the $EtCO_2$ Averaging menu.



NOTE

If an attempt is made to change CO_2 units after data has been collected, a message warning that trend memory will be erased is displayed. To change units and erase trends, press the OK key to continue, then the EXIT key to confirm and exit.

Configuration Settings

The CONFIGURATION menus can be programmed by the user to customize the *TIDAL WAVE Sp*. Any changes made will be retained when the monitor is turned off. NOTE: To reset the monitor to its factory default settings: with the monitor off, press and **hold** the key and the key, then press the key to turn the monitor on.

Options are listed below with descriptions following:

Parameter	Settings and Description	Factory Default
GAS COMPENSATION	Room air, O_2 > 60%, N_2O > 60% Use this setting to enter the gas composition in order to compensate the CO_2 measurement for gas density. Any setting other than the default will cause the monitor to display "O_2" or "O_2 N_2O" on the screen beside the respiration value.	Room Air
CO_2 WAVEFORM SCALE	Small, Medium, Large Select the desired size of the capnogram waveform.	Medium
CO_2 WAVEFORM SPEED	Slow, Fast, Medium Select the desired speed of the capnogram waveform.	Medium
NO RESP TIMER	20 sec., 40 sec., 60 sec. Alert setting activates if the end tidal CO_2 portion of the monitor cannot detect regular breaths for periods longer than 10 seconds.	20 sec.

CO_2 UNITS	mmHg, kPa, % Select the desired units for both the capnogram and $ETCO_2$ values. Note that changing the CO_2 units in the Configuration menu will result in a loss of all stored data. The message "WARNING: CHANGING CO2 UNITS ERASES STORED TRENDS" will display. Press CANCEL, or press the OK key to acknowledge the warning, and return to the CO2 UNITS menu. Press the Adapter key to EXIT	mmHg
ALERT VOLUME	Disabled, Low, High Select the desired volume of audible alerts. Note that care should be taken to set the volume level above ambient noise levels.	High
RS232 INTERFACE	NOVACOMM (used when connected to an external PC with optional software), SEIKO 414 (used when connected to the Seiko DPU-414 Thermal Printer), RESERVED 1, and RESERVED 2 (Novametrix use).	NOVACOMM
WAVEFORM FILL	Unfilled, Filled Select the desired appearance of the capnogram waveform.	Unfilled
$ETCO_2$ AVERAGING	1 Breath, 10 sec, 20 sec, INST Select the interval from which the displayed value of end tidal CO_2 ($ETCO_2$) is calculated.	10 sec
SpO_2 AVERAGING	2 sec, 8 sec Select the interval from which the displayed value of oxygen saturation (SpO_2) is calculated.	8 sec
ALERT LIMITS	Disabled, Enabled Enable or disable the Alert Limits function. Select the desired high and low alert limits by exiting the CONFIGURATION menu and pressing the Alert key.	Disabled
PULSE BEEP VOLUME	Off, Low, High Select the desired volume of pulse beep. Note that care should be taken to set the volume level above ambient noise levels.	OFF
RESP TREND SCALE	Small, Medium, Large Select the desired size of the respiration trend waveform.	Medium
AUTO POWER OFF	Enabled, Disabled Selects automatic shut off of unit if no signal is detected, to conserve battery power.	Enabled

The following parameters are accessed by pressing ☼ from one of the previous Configuration menus. Press ☼ to move through the menus.

SET TIME AND DATE	Press the 24 hour format. Day number, short month name, year (e.g. 14-DEC-1998) (From within the CONFIGURATION Menu, press ☼ key to access this screen). Select to program or change the time and date. The format is "TIME: HH:MM DDmmmYYYY" where HH=hours from 00-23, MM=minutes from 00-59, DD=days of the month from 01-31, mmm=month, YYYY=year (using all four digits).	
LANGUAGE	All languages available in the current software release are listed in this menu.	
SOFTWARE REVISIONS MAIN PROGRAM	Date, time and version of 710/715 software currently loaded in to this unit.	
CAPNOSTAT SERIAL # VERIFY ACCURACY	Serial number of CAPNOSTAT CO_2 sensor attached to this monitor. Verifying monitor accuracy with calibration gas should be performed only by qualified service personnel.	

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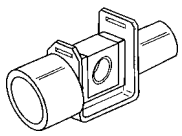
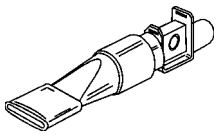
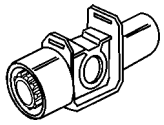
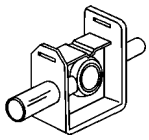
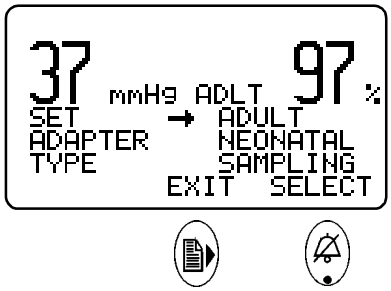
Section 4 *Sensors and Patient Connections*

Adapter Types Available

	**Pediatric/Adult Single Patient Use Airway Adapter (Catalog No. 6063):** • For intubated patients with endotracheal tube diameters greater than 4 mm. Adds approximately 5 cc of deadspace; • For connecting to anesthesia, non-rebreathing, or BIPAP/CPAP masks for non-intubated patients.
	**Pediatric/Adult Single Patient Use Airway Adapter with mouthpiece (Catalog No. 6421):** • For point-of-care monitoring of pediatric or adult patients. Adds approximately 8 cc of deadspace.
	**Neonatal/Pediatric Single Patient Use Airway Adapter (Catalog No. 6312):** • For intubated patients with endotracheal tube diameters no more than 4 mm. Adds approximately .5 cc of deadspace.
	**Sampling Adapter, Single Patient Use (Catalog No. 8954):** • For monitoring non-intubated patients with nasal cannulas. • For monitoring pediatric tracheostomy patients.

Setting Adapter Type

The *TIDAL WAVE Sp* uses three types of disposable, Single Patient Use adapters: Adult/Pediatric, Neonatal and Sampling. Press the Adapter key to access the adapter menu, then the SELECT key to move the arrow pointer to the correct type. The selected adapter type is displayed in the message area in the center of the display screen.



If the adapter type placed on the CAPNOSTAT CO_2 sensor does not match the currently selected adapter type, a "CHECK ADAPTER" message will appear. If the adapter type is correct, see the "Adapter Zero Procedure" on page 22.

Adapter Zero Procedure

An adapter zero allows the monitor to accommodate the optical characteristics of each different type of adapter. Before zeroing, verify the selected adapter type is correct, and the adapter setting is correct.

NOTE

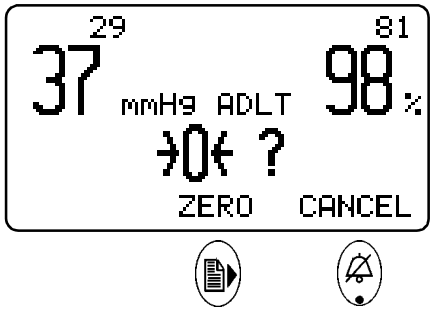
- This procedure is to be performed with a new unused single patient use adapter only! Perform this procedure only if the CHECK ADAPTER message persists, or if deemed necessary by qualified personnel.
- Do not perform this procedure while the CAPNO WARMING (Model 710) message is displayed.
- Do not perform this procedure while the adapter is connected to a breathing circuit, mouthpiece or mask on a patient.
- The pediatric/adult, neonatal and sampling adapters must be zeroed independently (ensure that the proper adapter type is selected).

1. Attach the selected adapter type to the CAPNOSTAT CO_2 sensor. Select the adapter type (pediatric/adult, neonatal or sampling) to be zeroed by pressing the Adapter key to access the adapter menu. Press the SELECT key to move the arrow pointer to the correct type of adapter and confirm the selection with the EXIT key.
2. Press and hold the Adapter key for five seconds to enter the zero menu.

WARNING

- Zeroing with the incorrect adapter type will cause incorrect readings.
- Zeroing the wrong adapter type on the wrong adapter setting will cause incorrect readings.
- Do not zero the CAPNOSTAT CO_2 sensor without a single patient use adapter attached. Incorrect readings or no readings will result.

3. With all sources of CO_2 away from the adapter (including the patient's - and your own - exhaled breath), press the ZERO key to begin the procedure or CANCEL to exit.



NOTE

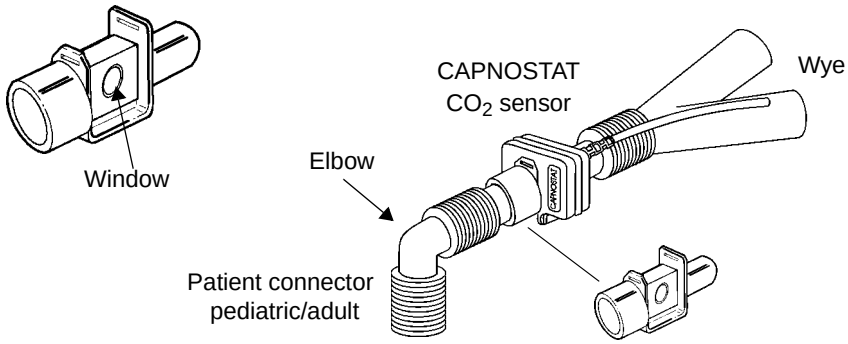
- If breaths are detected while attempting to zero the adapter, the icon will display and the zero menu will be exited automatically (remove the CO_2 source, wait 15 seconds and repeat the procedure from step 1).
- If the sensor is not at the proper temperature, the icon will display and the zero menu will be exited automatically (wait 15 seconds and repeat the procedure from step 1).
- The *TIDAL WAVE Sp* will return to monitor mode automatically when the procedure is complete.
- When SAMPLING has been selected from the ADAPTER menu, the sampling pump will turn on when the CAPNOSTAT CO_2 sensor is snapped onto the sampling adapter.
- When zeroing the sampling adapter, place the cannula away from all sources of CO_2 including patient and operator breath, and ventilator exhaust valves. Verify the integrity of all pneumatic connections.

CAPNOSTAT CO_2 Sensor and Airway Adapter Setup

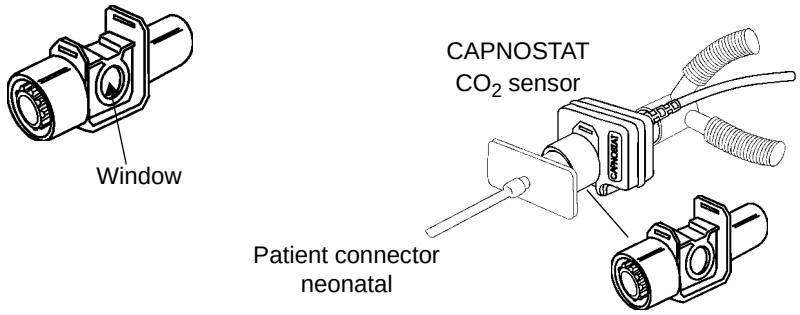
Patients requiring mechanical ventilation:

1. Select a new Single Patient Use airway adapter.
   (Pediatric/Adult - Cat. No. 6063 for ET tube size greater than 4.0 mm - see **Fig. 1**)
   (Neonatal Cat. No. 6312 for ET tube size 4.0 mm or less, see **Fig. 2**)
   Verify that the windows are clean and dry. Place the airway adapter in the patient's ventilator circuit. It should be positioned between the ET tube elbow and the circuit "wye" with its window in a vertical position.
   NOTE: In a pediatric or neonatal ventilator's circuit the elbow may not be present (**Fig. 2**).
2. Be sure the airway adapter is positioned vertically and located so that patient secretions and condensate water will flow **AWAY** from the adapter's windows, not through or into it.
3. Snap the CAPNOSTAT CO_2 sensor onto the airway adapter.
4. Capnogram (CO_2 waveform) or $EtCO_2$ trend, $EtCO_2$ values, and respiratory rate should be displayed on the monitor.

(Fig. 1) Pediatric/Adult Single Patient Use airway adapter Cat. No. 6063



(Fig. 2) Neonatal Single Patient Use airway adapter Cat. No. 6312

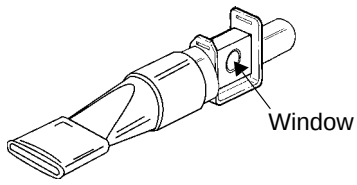


Spontaneously Breathing, Non-Intubated Patients

Mouthpiece:

1. Select an airway adapter with mouthpiece (Cat. No. 6421, **Fig. 3**)
2. Snap the CAPNOSTAT CO_2 sensor onto the airway adapter.
3. Instruct the patient to breath normally through his/her mouth while keeping a tight seal around the mouthpiece.
   NOTE: It has been reported in the literature that the presence of a mouthpiece may alter a patient's breathing pattern. This usually has a minor impact on $EtCO_2$.

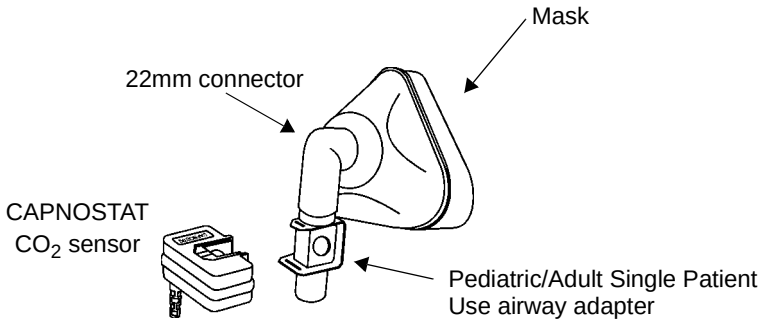
(Fig. 3) Pediatric/adult with mouthpiece Cat. No. 6421



Mask:

1. Select a new Single Patient Use airway adapter (Pediatric/Adult Cat. No. 6063).
2. Place the adapter onto a mask with a 22 mm connector (**Fig. 4**)
3. Place the mask on the patient's face and instruct him/her to breath normally.
   NOTE: If the patient requires low flow oxygen therapy it may be provided by placing the mask over the nasal cannula. This will have a minimal effect on $EtCO_2$ measurements.

(Fig. 4) Pediatric/Adult with Mask



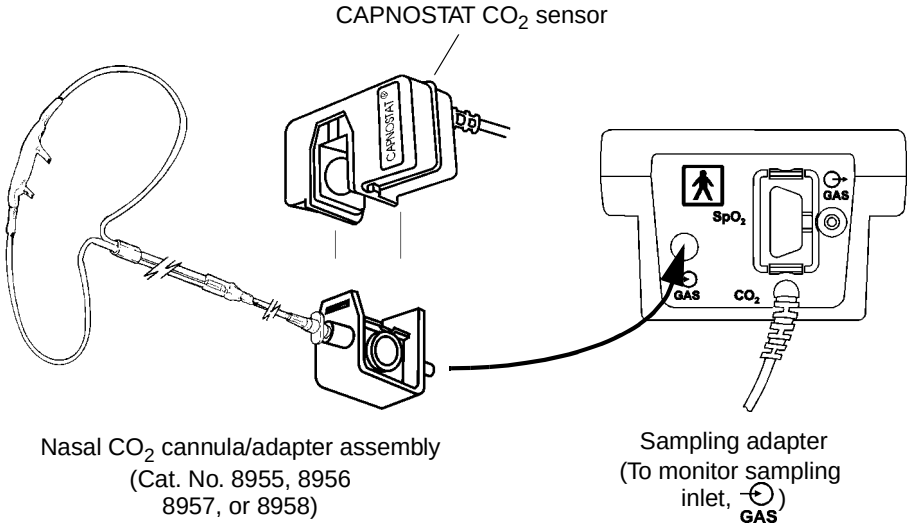
Sidestream Sampling (Model 715)

The Single Patient Use Sampling Airway Adapter (Cat. No. 8954) should be used in conjunction with a nasal sampling cannula to monitor non-intubated patients.

1. Select a new Single Patient Use sampling adapter.
2. Align the arrow on the bottom of the sampling adapter with the arrow on the bottom of the CAPNOSTAT CO_2 sensor and press the sensor and adapter together until they “click.”

3. Connect the nasal cannula/sampling adapter assembly to the Sampling Inlet GAS port located on the end of the monitor.

Cat. No.	Cannula Type
8955	Nasal CO_2 Sampling Cannula—Adult
8956	Nasal CO_2 Sampling Cannula—Pediatric
8957	Nasal CO_2 Sampling and O_2 Delivery Cannula—Adult
8958	Nasal CO_2 Sampling and O_2 Delivery Cannula—Pediatric



4. Ensure that the unit is in sampling mode:
   a. Press the Adapter key to set adapter type.
   b. Use the SELECT key until the arrow points to SAMPLING.
   c. Press the EXIT key to select SAMPLING.
5. When SAMPLING has been selected from the ADAPTER menu, the sampling pump will turn on when the CAPNOSTAT CO_2 sensor is snapped onto the adapter. The sampling adapter requires a zero when the monitor displays “CHECK ADAPTER”. To perform a zero, refer to “Adapter Zero Procedure” on page 22.
6. If using a Nasal CO_2 Sampling and O_2 Delivery Cannula, attach the O_2 tubing to the administration device and set the device to the prescribed O_2 setting.

7. Position the cannula on the patient.

   Insert the cannula tips into the nostrils, pass the cannula tubing over the ears, then slide the retaining sleeve up the tubing toward the neck to a comfortable fit under the chin.

8. Check that the connections have been made properly by examining the CO_2 waveform (capnogram) on the monitor display.

NOTE

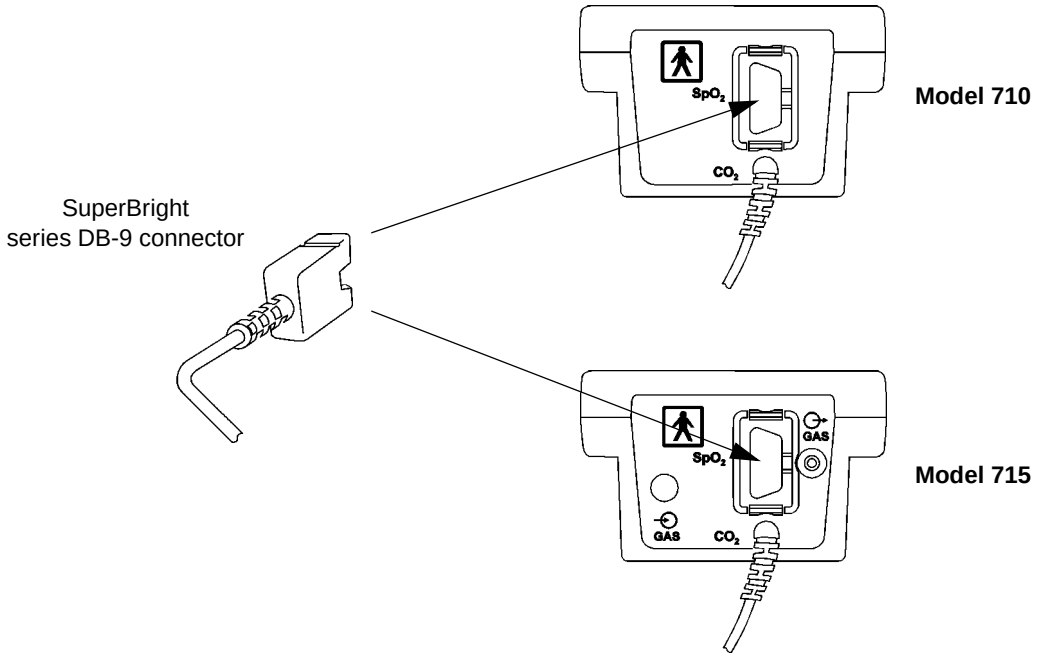
- If possible, position the Sampling Adapter with its windows in a vertical, and NOT a horizontal position; this helps keep moisture from "pooling" on the windows.
- To prevent "rain-out" and moisture from draining into the Sampling Adapter, do NOT place the Sampling Adapter in a gravity dependent position.
- If a Single Patient Use Sampling Adapter becomes occluded, replace and discard the adapter.

SpO_2 Sensors

CAUTION

Connect only Novametrix SpO_2 sensor extension cables and/or SuperBright™ SpO_2 sensors to the *TIDAL WAVE Sp.* Do not use other SpO_2 sensors or accessories with *TIDAL WAVE Sp*. Before connecting to the patient or to the monitor, ensure that sensor extension cables and/or sensors are physically intact, with no broken, frayed or damaged components.

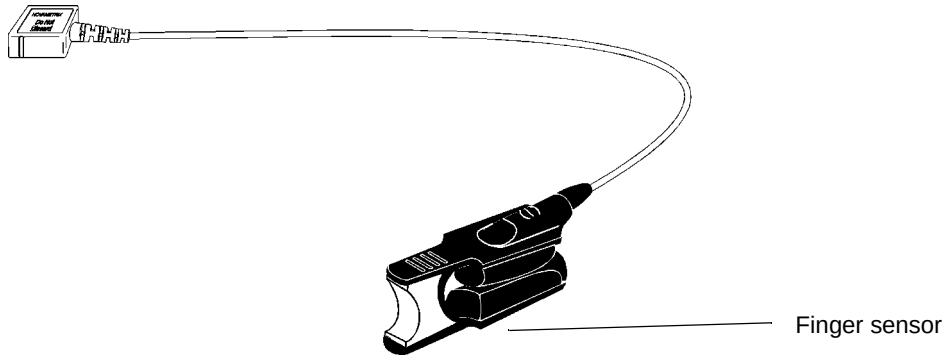
1. Plug the connector into the end panel SpO_2 sensor input. The sensor connector is keyed to fit into the input in only one direction.



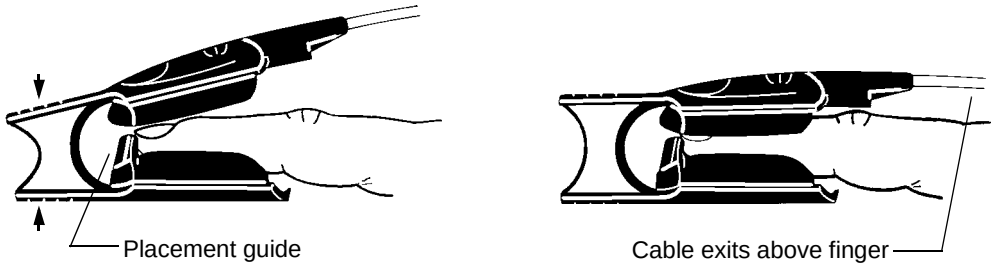
The connector clicks into place when properly seated. Sensors may be connected or removed whether or not the monitor is turned on.

Finger Sensor

The reusable Finger Sensor is intended for adult or appropriate size pediatric fingers and is not designed for neonatal applications.



1. Gently squeeze the grips at the rear of the sensor (indicated by arrows below).



2. Position fingertip against placement guide with fingernail toward the red light.

   Do not position the finger so as to protrude past the placement guide.

3. Release the finger grips.

WARNING

Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

4. To remove sensor, gently squeeze grips and slide the sensor from the finger.

CAUTION

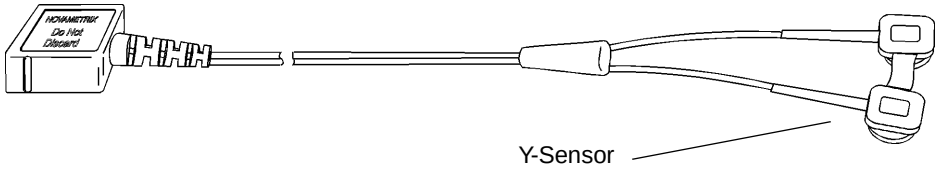
Overstretching the pulse oximeter finger sensor can damage the sensor and potentially affect pulse oximeter readings. Do not stretch the finger sensor open beyond the limit for which it was designed. Overstretching can be prevented: avoid opening the sensor by any means other than squeezing the grips; *DO NOT* force the sensor onto large objects such as a bedrail.

Finger Sensor Quick Check

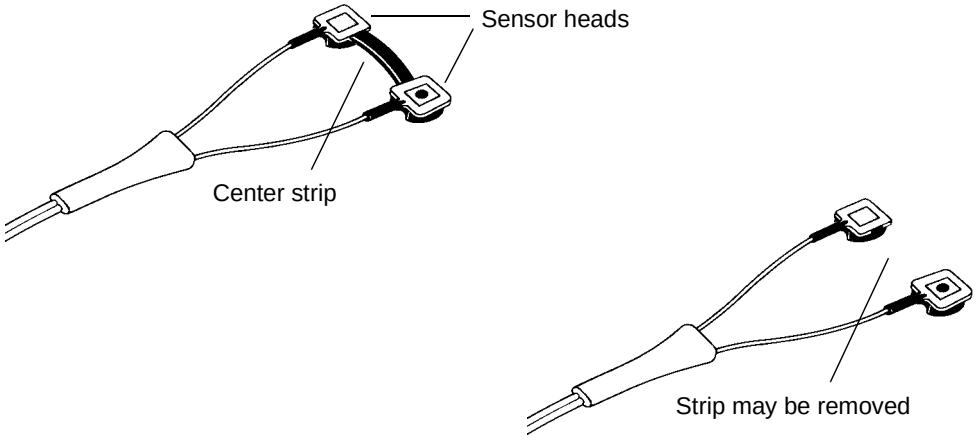
1. Is "SPO2 PRB OFF PAT" displayed when the sensor is connected to the monitor but not applied to the patient?
2. Apply the sensor to your index finger. Are reasonable SpO_2 and pulse rate values displayed?
3. A YES to BOTH #1 and #2 indicates that the sensor is OK. Apply the sensor to the patient as instructed above. The quick check is also a functional test of the extension cable.

Y-Sensor™

The reusable Y-Sensor is a flexible sensor designed for use on any patient. It is secured to the patient using a Y-Strip tape, foam wrap, or ear clip (see below).

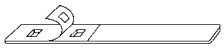
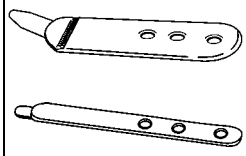
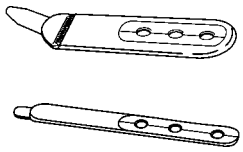


The Y-Sensor center strip is not a functional part of the sensor. Its twofold purpose is to aid in the placement of the sensor into the Y-Strip or other securing system and to keep the distance between the sensor heads to no more than 25 mm. The center strip may be removed (carefully cut away) if the distance between the sensor heads needs to be reduced to less than 25 mm.



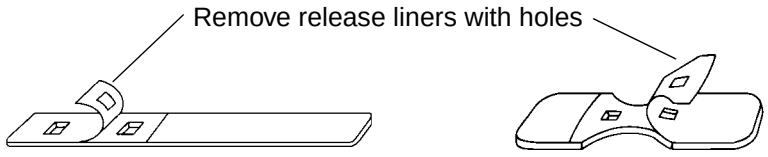
Y-Sensor Application using Y-Strip Tapes or Foam Wrap

Select a Y-Strip or foam wrap based on the patient type and intended sensor location.

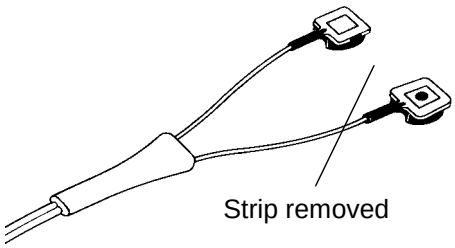
	**Wrap Style Tapes:** Y-Strip tapes are available in two color coded sizes: 25 mm tapes have green liners, and 20 mm tapes have blue liners. The size refers to the distance between the holes in the tape. • Catalog No. 8828: 20mm (blue) neonatal foot, hand, pediatric toe, finger • Catalog No. 8829: 25mm (green) neonatal foot, hand
	Finger Style Tapes: • Catalog No. 8831: 20mm (blue) pediatric finger, adult finger • Catalog No. 8832: 25mm (green) adult finger
	**Non-Adhesive Foam Wraps:** • Catalog No. 8836, Large: adult/pediatric finger, neonatal/pediatric foot or hand • Catalog No. 8943, Small: neonatal foot or hand, pediatric toe or finger
	**Adhesive Foam Wraps:** • Catalog No. 6929, Large: adult/pediatric finger, neonatal/pediatric foot or hand • Catalog No. 6968, Small: neonatal foot or hand, pediatric toe or finger

To use the Y-Strip tapes:

1. Remove the portion of the release liner containing the holes.



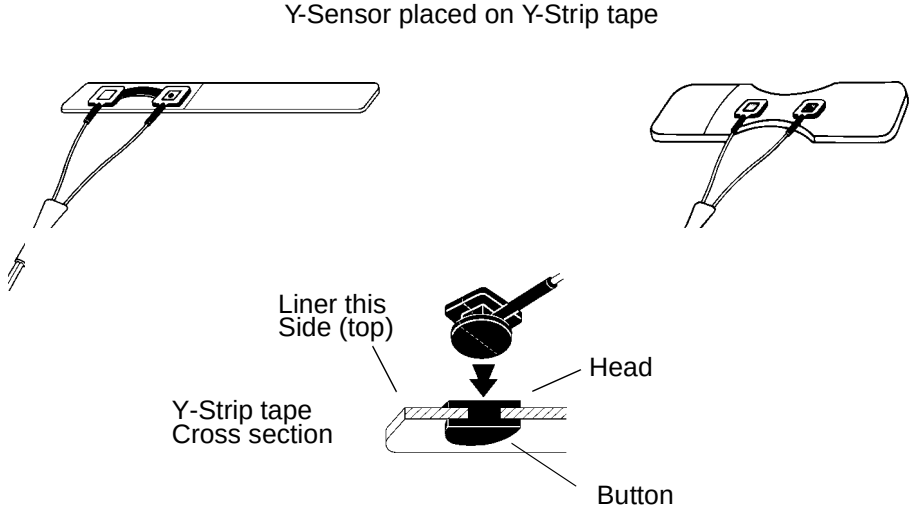
2. *(Omit this step if using the 25 mm Y-Strip tape.)*
   If using the 20 mm Y-Strip tape, carefully remove the Y-Sensor center strip using a pair of scissors or a sharp blade.



   The center strip does not effect sensor operation; its purpose is to aid putting the sensor into the 25 mm tape and to keep the distance between the sensor heads at 25 mm.

3. Press the "button" on the back of each sensor head through a hole in the tape.

   Press in from the sticky side of the tape. The tape will stretch to fit the sensor button.



4. Remove the remaining release liner(s) if applicable and apply the sensor/tape to the patient.

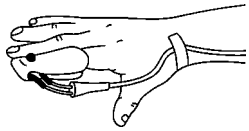
   Make certain that the sensor heads are directly opposite each other through the tissue. This prevents the sensor from being placed on a site too thick for proper operation.

   Position the sensor so that the tape does not extend over the space between the fingers or toes to insure that there will be no light transmission through this space.

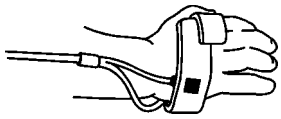
5. To maximize sensor life, secure the cable along the limb with tape as shown in the following illustrations.

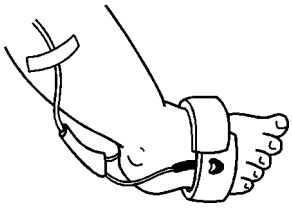
Leave slack in the wires between the tape and the sensor.

Adult/pediatric finger

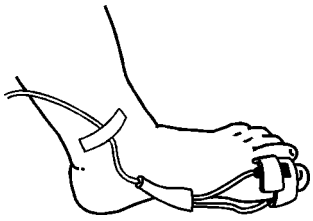


Neonatal hand





Neonatal/pediatric foot



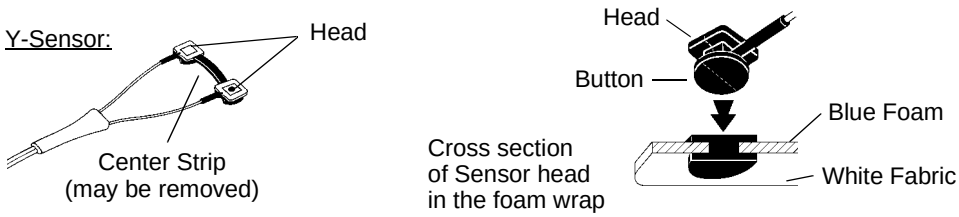
Pediatric toe

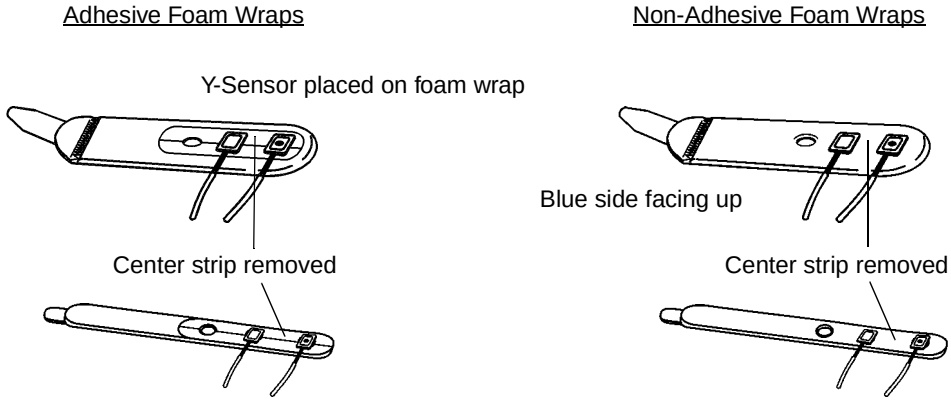
WARNING

Do not wrap the tape around the limb so tightly that circulation is restricted.
Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

To use the adhesive or non-adhesive foam wrap:

1. With the blue side of the foam wrap facing up, press the buttons on the back of each Y-sensor head through the holes in the foam wrap. The wrap will stretch to fit the buttons. The white side of the foam should show two blue circles where the buttons were pushed through.





NOTE

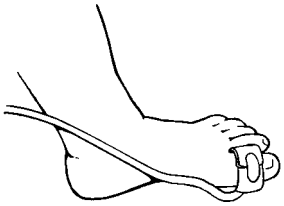
If using the first and third holes on the foam wrap it may be necessary to cut the center strip off the Y-sensor.

2. If you are using an adhesive wrap, remove both sides of the release liner. Face the blue side of the wrap toward the skin and wrap around the site (Velcro tab may be removed and replaced to allow excess foam to be cut as necessary). Secure with the Velcro® tab.

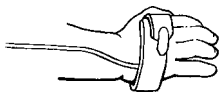
WARNING

Do not wrap the tape around the limb so tightly that circulation is restricted.
Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

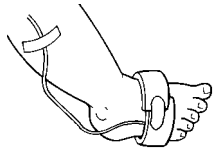
3. *Ensure the sensor heads are directly opposite each other through the tissue.* This prevents the sensor from being placed on a site too thick for proper operation.



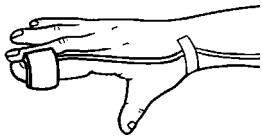
Pediatric toe



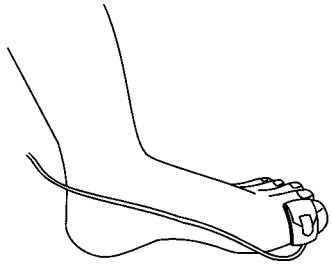
Neonatal hand



Neonatal/pediatric foot



Adult/pediatric finger



Adult toe

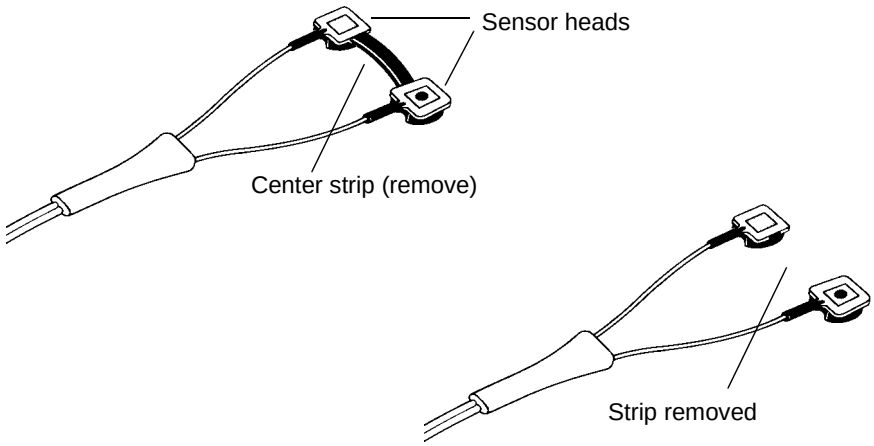
4. Position the sensor so that the foam wrap does not extend over the spaces between the fingers or toes. This ensures no light transmission through this space. To maximize sensor life, secure the cable along the limb with tape as shown in the illustrations.

WARNING

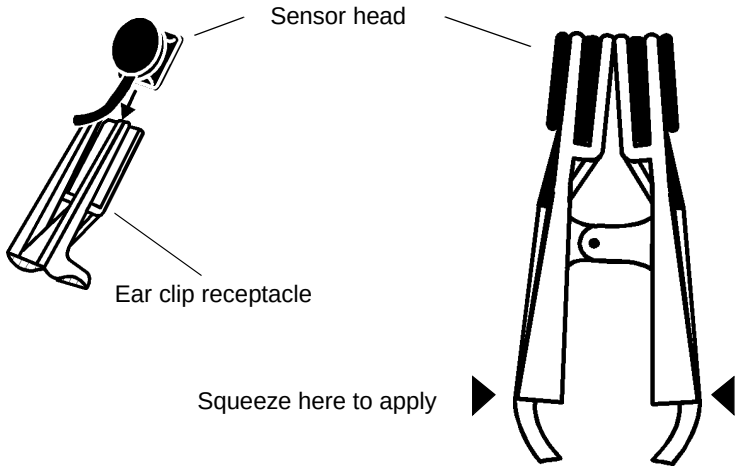
Treat foam wrap in accordance with hospital protocol for single-patient use. Check site regularly to ensure adequate circulation and proper sensor positioning.

Y-Sensor Application using Ear Clip

1. Remove center strip from the Y-Sensor.

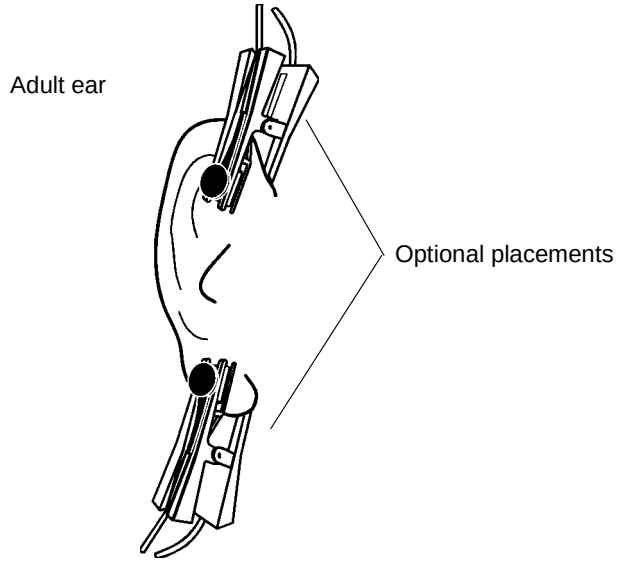


2. Slide each Y-Sensor head into the ear clip‘s receptacles. The heads should face each other.



3. Gently squeeze the end of the ear clip (shown in diagram), and apply the sensor to the patient.

If a satisfactory reading cannot be obtained, rub the site and/or use adhesive dots for better response. The adhesive dots (Catalog No. 8700) included with the ear clips will also help in preventing the ear clip from falling off (during exercise for example).



WARNING

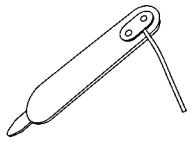
Inspect the site often for adequate circulation—at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

Y-Sensor Quick Check

1. With the Y-Sensor connected to the monitor but not applied to patient, position the sensor heads so that they face each other (the red light shines at the detector). Is "SPO2 PRB OFF PAT " displayed?
2. Tape the Y-Sensor to your index finger. Does the monitor show reasonable SpO_2 and pulse rate values?
3. A YES to BOTH #1 and #2 indicates that the sensor is working properly. Apply the sensor to the patient as instructed above. The quick check is also a functional test of the extension cable.

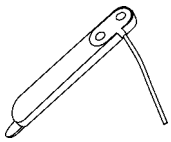
Single Patient Use SpO_2 Sensors

Select a Y-Strip or foam wrap based on the patient type and intended sensor location.



Single Patient Use Pediatric/Adult Sensor (Catalog No. 6455):

- The single patient use SpO_2 sensor can be used when monitoring adult or pediatric patients with Novametrix Pulse Oximeters (SuperBright series).



Single Patient Use Neonatal/Pediatric Sensor (Catalog No. 6480):

- The single patient use SpO_2 sensor can be used when monitoring neonatal or pediatric patients with Novametrix Pulse Oximeters (SuperBright series).

WARNING

Use the Single Patient Use sensor and DB-9 extension cable only with Novametrix SuperBright compatible pulse oximeters. Use with any other device may result in equipment damage or patient injury.

CAUTION

These SpO_2 sensors are intended for single patient use. The sensors can be reapplied to various sites on the same patient but should not be used on multiple patients. Do not attempt to clean or disinfect the sensor, as system performance will be compromised.

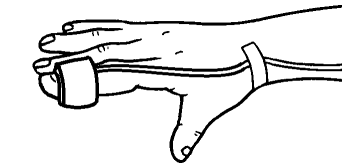
NOTE

The Single Patient Use sensor should be discarded if sensor integrity becomes questionable.

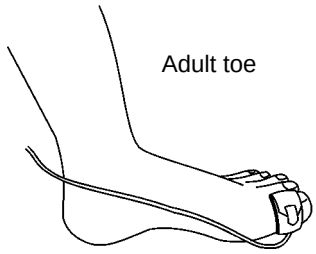
Single Patient Use SpO_2 Sensor Application

1. Select the appropriate size sensor based on the patient type. Connect the DB-9 connector to the *TIDAL WAVE Sp* rear panel connector.

Pediatric/adult sensor

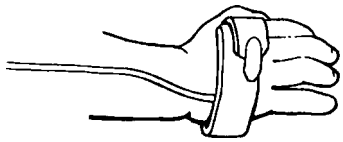


Adult finger

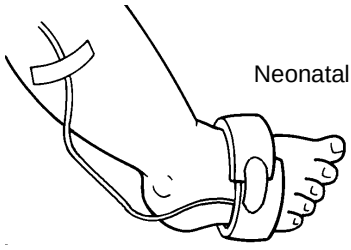


Adult toe

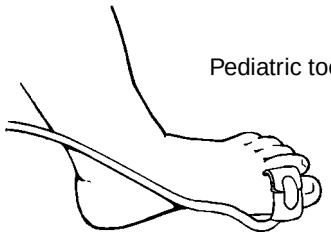
Neonatal/pediatric sensor



Neonatal hand



Neonatal foot

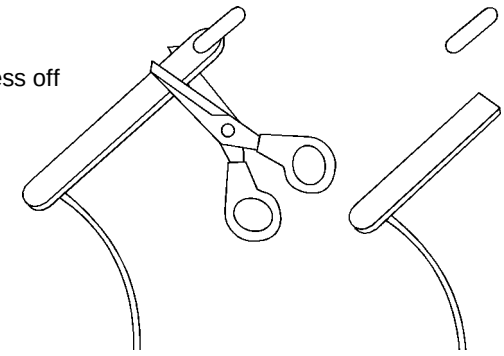


Pediatric toe

2. To apply the sensor, place the blue side of the sensor wrap against the skin, wrap it around the site and secure with Velcro* tab. The Velcro tab on the neonatal/pediatric version is removable to allow the foam wrap to be cut before applying to the patient.

Neonatal/pediatric sensor

Cut excess off



Reattach Velcro tab

*Velcro is a registered trademark of Velcro USA, Inc.

Make certain that the sensor heads are positioned directly opposite each other through the tissue. The adhesive dots (Catalog No. 8700) which are included with each sensor can be applied to the sensor before patient application for additional adhesion to the site.

3. For additional support, secure the cable along the limb with tape. An extension cable (Cat. No. 9174-00) is available for use with the disposable sensors.

WARNING

Do not wrap the sensor around the limb so tightly that circulation is restricted. Inspect the site often, at least every four hours, for adequate circulation. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.

Single Patient Use SpO_2 Sensor Quick Check

1. With the sensor connected to the monitor but not applied to patient, position the sensor heads so that they face each other (the red light shines at the detector). Is "SPO2 PRB OFF PAT" displayed on the screen?
2. Attach the Single Patient Use sensor to your index finger. Does the monitor show reasonable SpO_2 and pulse rate values?
3. A YES to BOTH #1 and #2 indicates that the sensor is working properly. Apply the sensor to the patient as instructed above. This quick check is also a functional test of the extension cable.

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Section 5 Monitoring

Display of Data

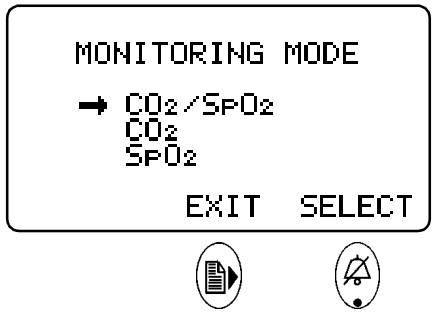
The *TIDAL WAVE Sp* measures and displays $EtCO_2$, respiration rate, saturation and pulse rate. Until valid data is received for any parameter, that parameter will show a dash "--". When valid data is received, the value will display. If the parameter is lost, the value will return to dashes "--".

This will also occur when the monitor is first turned on and before any valid patient data is obtained. When monitoring, if valid data is received then lost for $ETCO_2$, respiratory rate, SpO_2, or pulse rate, an alert condition will occur. If the Alert key is pressed, and valid data is still not available, the numeric value of the parameter in question will display "--". If the key is not pressed within 30 seconds after the loss of data, the display will automatically turn to dashes "--".

Monitoring Mode

Three monitoring modes are available for the *TIDAL WAVE Sp:* CO_2/SpO_2, CO_2 and SpO_2. The factory default is CO_2/SpO_2. To choose a different mode, press and hold the Power key to access the menu. The currently selected mode will flash. Press the SELECT key to move the arrow pointer to the correct mode and the EXIT key to exit the menu.

When the monitor is in CO_2 mode, SpO_2 screens are not be available; in SpO_2 mode, CO_2 screens are not available. All screens are available in CO_2/SpO_2 mode.



NOTE

Significant power savings can be realized by shutting down monitor functions that are not currently being used. Refer to "Battery Life and Recharge Times" on page 14.

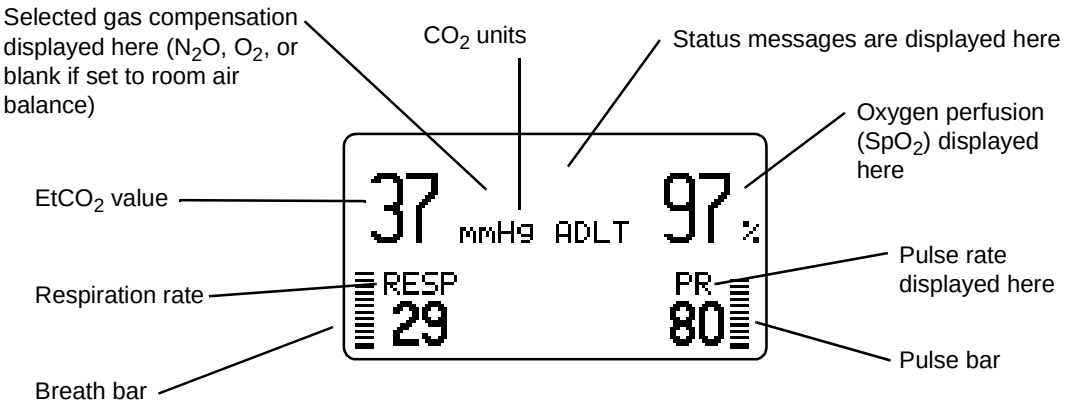
Parameters are measured and displayed on the various screens in the following sections.

Screen Displays

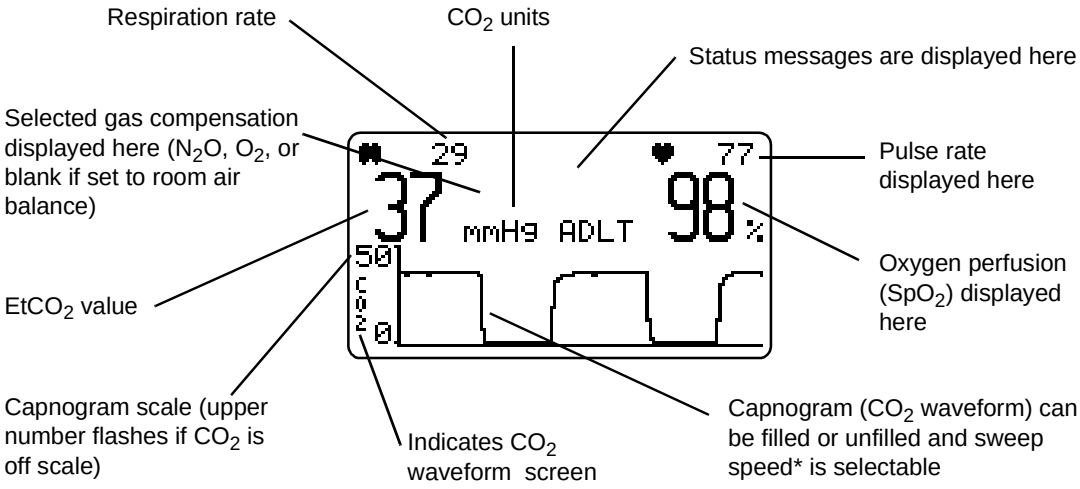
The last screen used will automatically appear on power-up, with the exception of the Trend screens.

Data Screen

The Data screen displays End Tidal CO_2, respiration rate, oxygen saturation, and pulse rate in larger, easy-to-read text, without waveforms. A pulse bar that is proportional to the signal strength, appears in the lower right corner, indicating the patient's pulse; a breath bar in the lower left corner indicates the patient's inhaled and exhaled breaths.



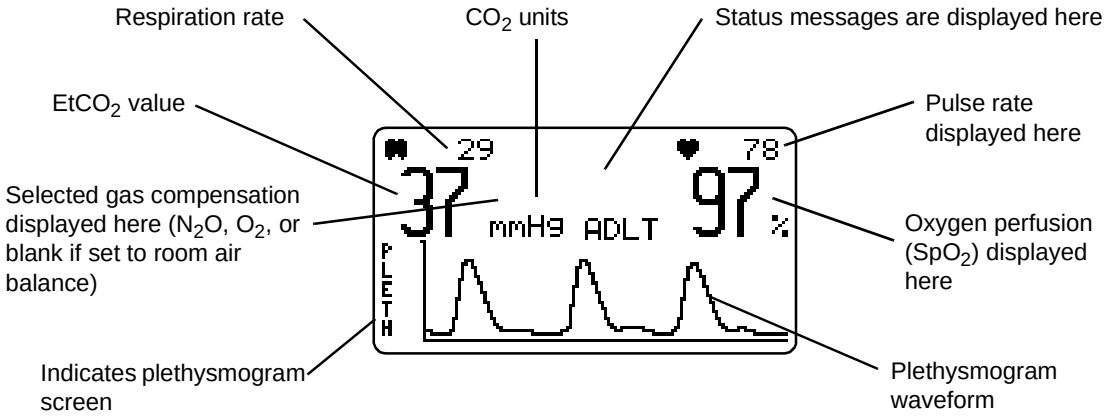
CO_2 Waveform Screen (Capnogram)



*NOTE: The capnogram sweep speed is automatically adjusted when switching modes. It will increase one step when switched from adult to neonatal, and decrease one step when switched from neonatal to adult.

SpO_2 Waveform Screen (Plethysmogram)

The pitch of the (user selectable) Pulse Rate "beep" tracks the SpO_2 value. Decreasing SpO_2 values are signaled by lower-pitched beeps; increasing values are signaled by higher-pitched beeps. The plethysmogram waveform is proportional to the signal strength.



Trend Screens

On-screen trends are displayed as a graph. Use the key to advance to the $EtCO_2$, Respiration Rate or SpO_2 trend screen. Thirty (30) minutes of data are displayed, moving from right to left on the screen.

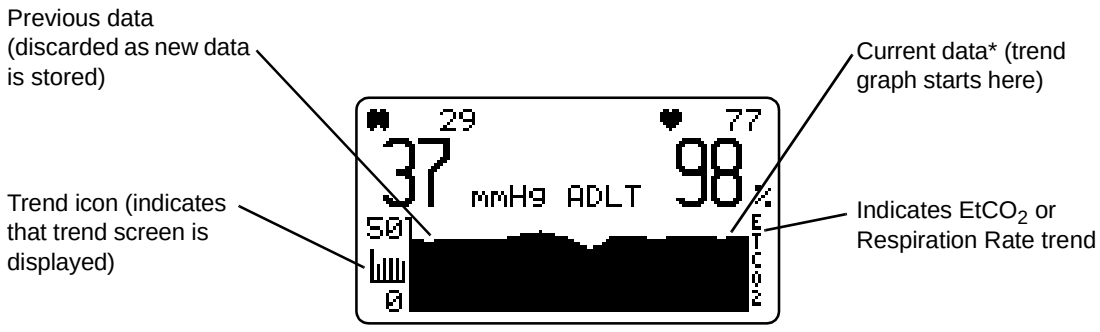
Each data point represents 16.8 seconds. New data is added on the right side of the screen. Refer to the CONFIGURATION menus for scale adjustment.

NOTE

Changing the CO_2 UNITS in the Configuration menu will result in a loss of all stored data.

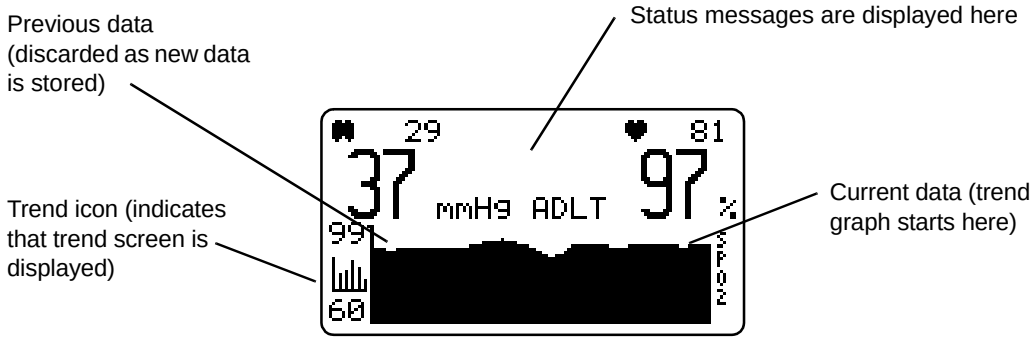
When changing CO_2 UNITS in the Configuration menu, the message "WARNING: CHANGING CO2 UNITS ERASES STORED TRENDS" will display. Press the OK key to acknowledge the warning (this does not erase the data), and return to the CO2 UNITS menu. Select the correct unit or press to EXIT.

$EtCO_2$ and Respiration Rate Trend Screen



* Thirty (30) minutes of data are displayed moving from right to left on the screen. Each data point represents 16.8 seconds.

SpO_2 Trend Screen



Trend Memory

In addition to on-screen trends, the *TIDAL WAVE Sp* has internal, battery-backed, trend memory that stores $EtCO_2$, respiration rate, SpO_2 and pulse rate calculated parameters for 24 hours at an eight second resolution. The chart below describes the storage interval for each parameter. Stored parameter values can be downloaded (transferred) to a PC and viewed using the optional NovaCARD software or printed on the Seiko DPU-414 Thermal Printer. See "Printing and RS232 Options" on page 53 for more information.

To erase stored trends press and hold both and keys after pressing the key to power the monitor on.

Trending Storage Interval	
$ETCO_2$	Maximum value
Resp. Rate	Average
Inspired CO_2	Maximum value
SpO_2	Average
Pulse Rate	Average

Messages

Status Messages

Status messages indicate conditions that should be corrected or monitored; they may or may not be tied to an alert condition. These conditions can be a result of a hardware or sensor fault condition. Status messages are displayed on the screen in the same manner as alert messages. Following is a list of status and alert messages that may appear on the monitor.

System Messages

Message	Description
PRESSURE FAULTY	The barometric pressure sensor is returning a value which is out of range (<400 mmHg or > 800 mmHg). The monitor will default to 760 mmHg for calculation purposes. Refer servicing to qualified personnel.
EtCO2 AUTO LIMITS SET SpO2 AUTO LIMITS SET	This message is displayed when the monitor has successfully determined and set the auto alert limits for SpO_2 and $ETCO_2$.
RESETTING TO FACTORY DEFAULTS	All setup and alert settings have just been reset to factory default values.
ERASING STORED TRENDS	The trends stored in the monitor's memory have been erased.
CHECK CLOCK TIME AND DATE	Time and date may not be properly set. The time and date can be adjusted in the CONFIGURATION menu by pressing the ☼ Backlight key. See "Configuration Settings" on page 17.
AUTO POWER OFF IN X:XX	The monitor will shut off if there is no CO_2 breath detection or key depressions for ten minutes from when the unit powers on. The timer (X:XX) will then count down from two minutes to zero. Pressing the adapter key, or detection of a CO_2 breath will cancel the shutdown.
UNKNOWN ERROR	Remove the monitor from use and contact Novametrix service personnel.

Capnography Messages

Message	Description
CAPNO WARMING	Sensor is under temperature. Wait for the CAPNOSTAT CO_2 sensor to reach operating temperature.
CHECK ADAPTER	Excessive moisture or secretions detected in the adapter: Change adapter. Adapter type has been changed (e.g. adult to neonatal): Zero the adapter. No adapter detected: Place an adapter on the CAPNOSTAT CO_2 sensor.
RESP=0 m : ss	A breath has not been detected for the indicated time (XX seconds). This message appears when the time since the end of expiration of the last detected breath exceeds the NO RESP TIMER setting in the configuration menu. See "Configuration Settings" on page 17.
INSP XX	An inspired CO_2 level of 3 mmHg (or 0.4% or kPa) was detected for 20 consecutive seconds.
ZRO: HOLD ADPT KEY	The current through the CAPNOSTAT CO_2 sensor source emitter has changed or the system is detecting $EtCO_2$ values less than -3.0 mmHg.

Message	Description
CAPNO FAULTY	The following errors may be present: 1. The current through the source is too high or low. 2. The checksum for the CAPNOSTAT calibration data is wrong. 3. The revision of the calibration data in the CAPNOSTAT is not compatible with the software in the *TIDAL WAVE Sp* Monitor. Refer servicing to qualified personnel.
CAPNO HI TEMP	The temperature of the case or detector heater is over 50°C. Refer servicing to qualified personnel.
CAN NOT ZERO CO2	An error was detected which did not allow the system to zero the current adapter being used. Refer servicing to qualified personnel.
CO_2 OUT OF RANGE	The detected waveform value is beyond the measurement range of the monitor (0-100 mmHg, 0-13.2% or kPa).
	A changing level of CO_2 was detected during an adapter zero procedure. Wait 30 seconds and retry.
	The CAPNOSTAT CO_2 sensor has not reached operating temperature while attempting to zero. Wait for the sensor to reach operating temperature.
ADAPTER ZERO IN PROGRESS, TIME REMAINING 0 : XX	An airway adapter zero is in progress. XX indicates the number of seconds remaining.
WARNING: CHANGING CO2 UNITS ERASES STORED TRENDS	Changing CO_2 units (mmHg, %, kPa) in the Configuration menu will cause this message to appear.

Oxygen Saturation Messages

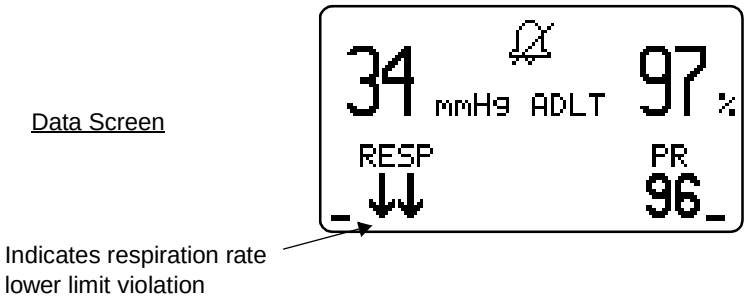
Message	Description
SPO2 LOW STRENGTH	The pulse strength as detected by the sensor is too small for proper monitor operation. This message will disappear when the problem is corrected.
INSUFF LIGHT	Sensor is placed on a site too thick (opaque) for adequate light transmission. Move sensor to a different site.
PULSE RANG ERR	Pulse must be within 30-250 beats per minute, inclusive.
SHIELD SPO2 PRB	Ambient light source (sunlight, warming lights, etc.) are interfering with sensor operation. Shield sensor from these light sources.
SPO2 PRB FAULTY	Remove sensor from use and contact qualified service personnel.
SPO2 BAD SIGNAL	Monitor not receiving valid signals from the sensor. May be caused by excessive motion, cardiac arrhythmia or other situations leading to poor signal.
CONNECT SPO2 PRB	Sensor not connected to unit.

Message	Description
SPO2 PRB OFF PAT	Sensor not on patient.
MONITOR FAULTY	Remove the monitor from use and contact qualified service personnel.

Alerts

Alerts are generated for $ETCO_2$, respiration rate, SpO_2, and pulse rate. These alerts occur when the high or low limits for a particular parameter are exceeded. There is also an alert when there is a loss of pulse rate, or when there is a loss of respiration for a consecutive twenty seconds (other limit times may be selected for the NO RESP TIMER, see “Configuration Menus” on page 16). Alert messages are displayed in the message center or in the particular area of the display when they occur. For example, a RESP=0 message will be displayed in the respiration section of the screen.

When any of the parameters are violated with alert limits ENABLED, two up ↑↑ or two down ↓↓ arrows will replace the parameter, indicating whether the violation was above or below the alert limit.



Setting Alert Limits

The alert limits for the monitor can be manually or automatically adjusted. To access AUTO ALERTS or SET ALERTS, the alert limits must be ENABLED from the Configuration menu. See “Configuration Menus” on page 16.

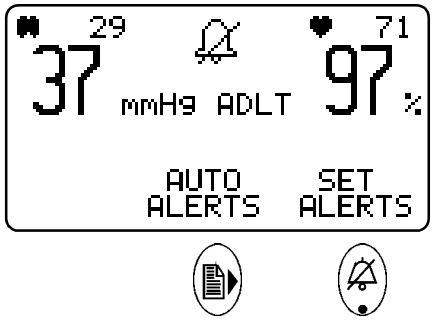
NOTE

To configure the monitor with the default limit values, power up while pressing and holding the Backlight and Alert keys. This will cause all parameters to return to their default values.

Manually Setting Alert Limits

Press the Alert key to access the ALERT menu. Press the SET ALERTS softkey to display the SET ALERT LIMITS menu. When selected, this screen will appear for 3 seconds, then automatically return to the previous display.

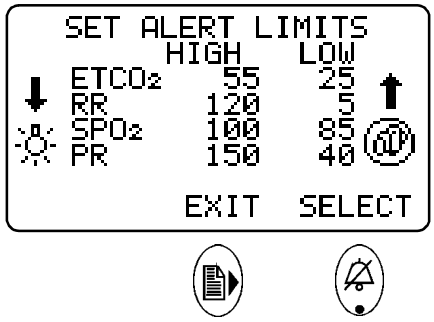
Alert Screen



Using the menu control keys, adjust the settings as desired: press the SELECT key to move to the desired parameter for adjusting; the selected parameter will flash. Use the Backlight key to decrease ↓ a parameter value and the Adapter key to increase ↑ the selected value.

Maximum and minimum high and low limits are preset for each parameter and cannot be exceeded. Also, the range between high and low alert limits is restricted to a minimum of five units. For example, default $ETCO_2$ settings are, high: 55 mmHg, low: 25 mmHg. If the user decreases the high setting to 30 mmHg (within 5 units of the low setting), and continues to lower the setting, *both* high and low $ETCO_2$ settings will decrease, maintaining the five unit range.

Selected parameter will flash



Default values are shown

NOTE

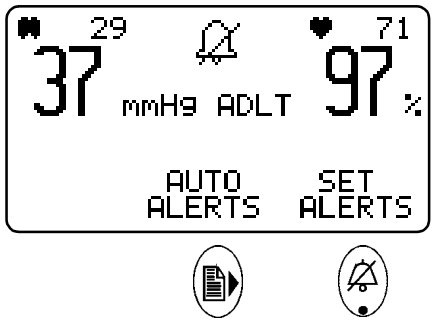
When the monitor is turned off, manual alert limit settings will be retained, even if AC power and the battery are disconnected.

Alert Limits Ranges	
$ETCO_2$	150 max 10 min
Resp. Rate	150 max 5 min
SpO_2	100 max 50 min
Pulse Rate	249 max 30 min

Auto Alert Limits

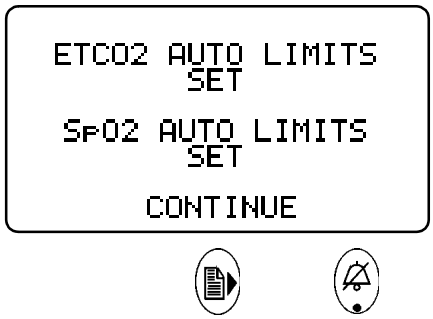
To set alert limits automatically, press the Alert key, and "AUTO ALERTS" will appear over the Page key. Press the Page key, and "ENABLE AUTO ALERTS?" will appear. Press "YES." The monitor will automatically set alert limits based on recent patient data.

Alert Screen



The screen will display "ETCO2 AUTO LIMITS SET" and "SPO2 AUTO LIMITS SET" messages. Press CONTINUE to return to the previous screen. If auto alert limits cannot be determined for one or both limits, the message "ETCO2 AUTO LIMITS NOT SET" and/or "SPO2 AUTO LIMITS NOT SET" will appear.

If one or both of the screen messages say "LIMITS **NOT** SET," exit this screen, resume monitoring and retry in 30 seconds when the monitor has collected sufficient data.



NOTE

Auto Alert Limits are not stored by the monitor. If Auto Alert Limits are selected and the unit is powered down, default limits will appear on power up, regardless of stored values.

Alert Audio

A NO RESPIRATION alert will sound after 20, 40 or 60 seconds (depending upon the configuration setting) if no breaths are detected. When this occurs a RESP=0 timer appears, indicating the number of seconds since the last detected breath. Three breaths must first be detected to initialize this alarm.

An audible alert is generated any time an alert condition is detected, provided that neither the 2 minute silence, nor the audible alert muting are enabled. If the ALERT VOLUME is set to DISABLED, an audible alert is not generated, and the alert silence LED will flash red.

Press the Alert key to silence an audible alert for 2 minutes. Press again to cancel.

Press and hold the Alert key to disable audible alerts. Press and hold again to cancel. The monitor will always power up with the audible alerts settings retained in memory.

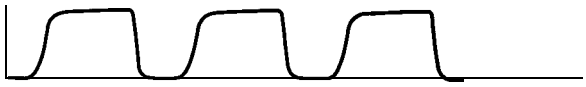
The audible alert volume can be adjusted or disabled from the CONFIGURATION menu. Press the Backlight and Adapter keys simultaneously, then the Page key until the ALERT VOLUME menu appears.

NOTE

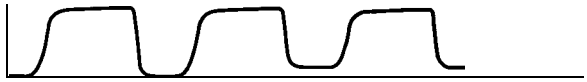
Make sure that the audible alert volume is not set too low to be heard over ambient noise levels.

Capnogram Sample Waveforms and Interpretations

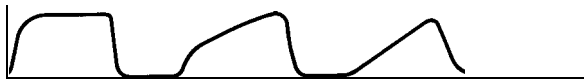
Normal: The "normal" capnogram is a waveform that represents the varying CO_2 level throughout the breath cycle.



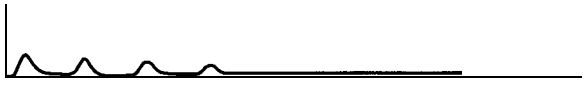
Rebreathing: Elevation of the baseline indicates rebreathing (may also show a corresponding increase in $EtCO_2$).



Obstruction: Obstructed expiratory gas flow is noted as a change in the slope of the ascending limb of the capnogram (the expiratory plateau may be absent).

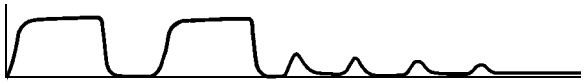


Endotracheal tube in the esophagus.



Inadequate seal around endotracheal tube: The downward slope of the plateau blends in with the descending limb.

Accidental extubation:



Reference Handbooks

For a discussion on waveform interpretations, refer to the Novametrix Reference Handbooks on capnography, respiratory mechanics, and pulse oximetry. Contact Novametrix Customer Service or your local sales representative for more information.

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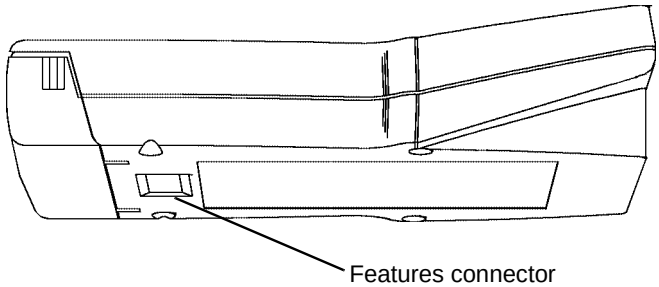
Section 6 *Printing and RS232 Options*

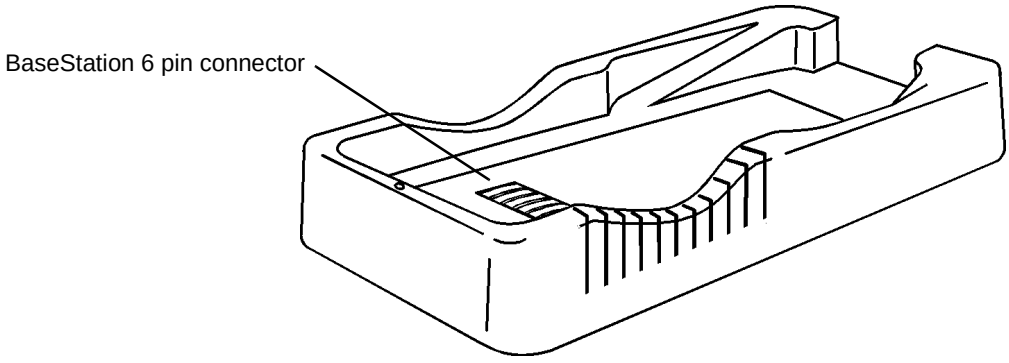
Power and RS232 Serial Port Communications

Two serial communications modes are available for the Model 710/715: the Seiko DPU-414 Printer or the NovaCOMM Interface, designed to output data in formats easily read by a computer or data logging device. The monitor must be placed in the BaseStation (PN: 6998-00) to use either serial communication mode.

Located on the BaseStation is a six pin modular contact which provides an RS232 interface as well as a power output for unit operation and battery charging when connected to Novametrix hand-held monitors. This connector meets the patient safety requirements of IEC 601-1 and UL544.

When the monitor is placed within the BaseStation, contact is made between the 6-pin connector in the BaseStation and the Features connector on the bottom of the monitor. This connection is transferred to the "RS232 Serial Port" connector on the BaseStation.

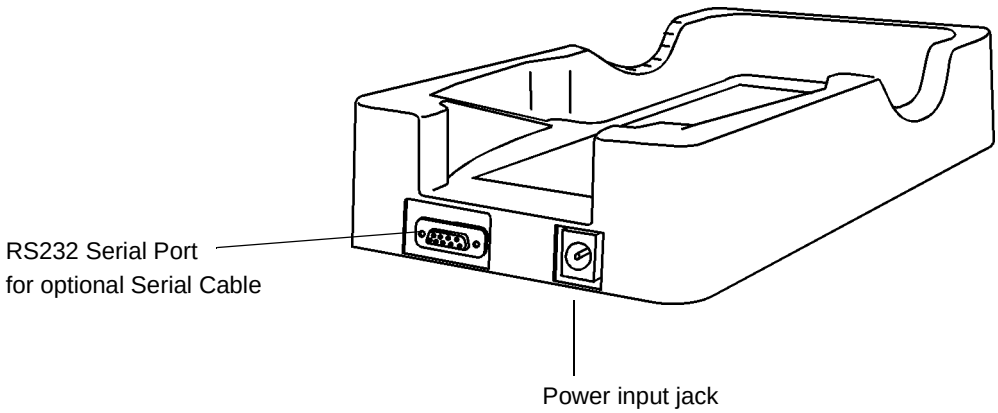




WARNING

Patient safety may be compromised if an external device (e.g. printer or computer) is connected to the RS232 serial port on the BaseStation.

The “RS232 Serial Port” 9 pin D connector allows connection to a host computer or printer.

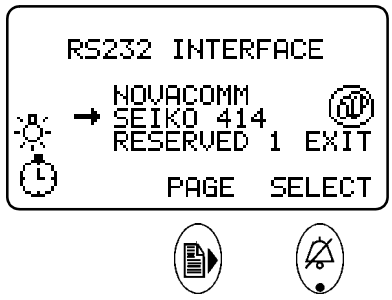


Downloading Data to a PC

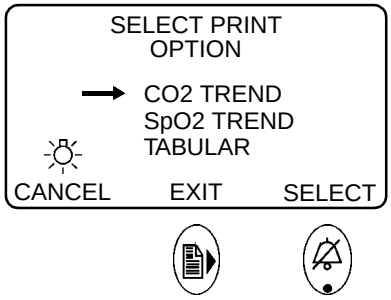
1. Connect the Serial Cable (PN: 600075, sold separately) to the RS232 Serial Port connector on the BaseStation.
2. Connect the external power supply to the power input jack on the BaseStation, then connect a line cord from the power supply to an AC source. It is recommended that the monitor be powered by the BaseStation using the external power supply when downloading data from the monitor or updating software. This will prevent power loss from a depleted battery.
3. Plug the other end of the serial cable into the host computer.
   NOTE: The COM port on the computer will be either a 9 pin or a 25 pin D connector. Use an adapter if the COM port on the host computer does not match the connector on the end of the Serial Cable.
4. Set the monitor inside the BaseStation, verify the “In Use” ∿ LED illuminates. Refer to the 6993-23 BaseStation User’s Manual for more information.

Printing

The monitor must be set up for printing in the Configuration menus. To access the Configuration menus, press and hold the Adapter key, then press the Contrast key. Press the PAGE key to advance to the RS232 INTERFACE menu, then the SELECT key to move the arrow pointer to “SEIKO 414”. Press the EXIT key to return to the main menu.

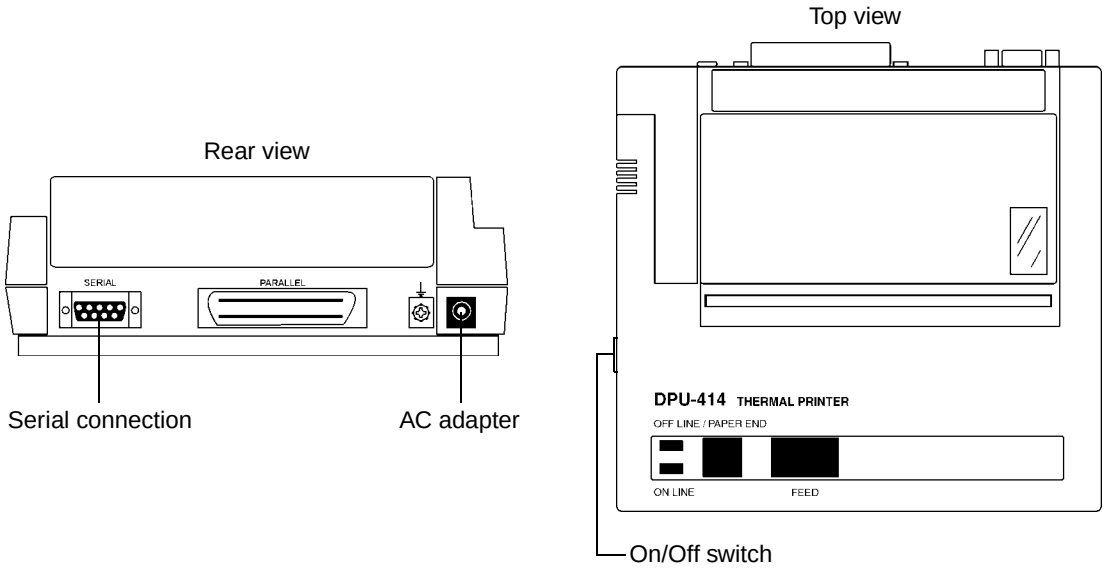


Once the print option is activated, press and hold the Page key for 3 seconds to access the SELECT PRINT OPTION menu. Press the SELECT key to move the arrow pointer to the correct option. CO_2 Trend, SpO_2 Trend and Tabular mode text printouts are available.



Configuring the Seiko DPU-414 Printer

The Seiko DPU-414 Thermal Printer (Cat. No. 9140-00) must be configured to communicate with the *TIDAL WAVE Sp*. When properly configured, the Seiko printer will retain the settings, even when turned off.



The printer must be configured to the following settings:

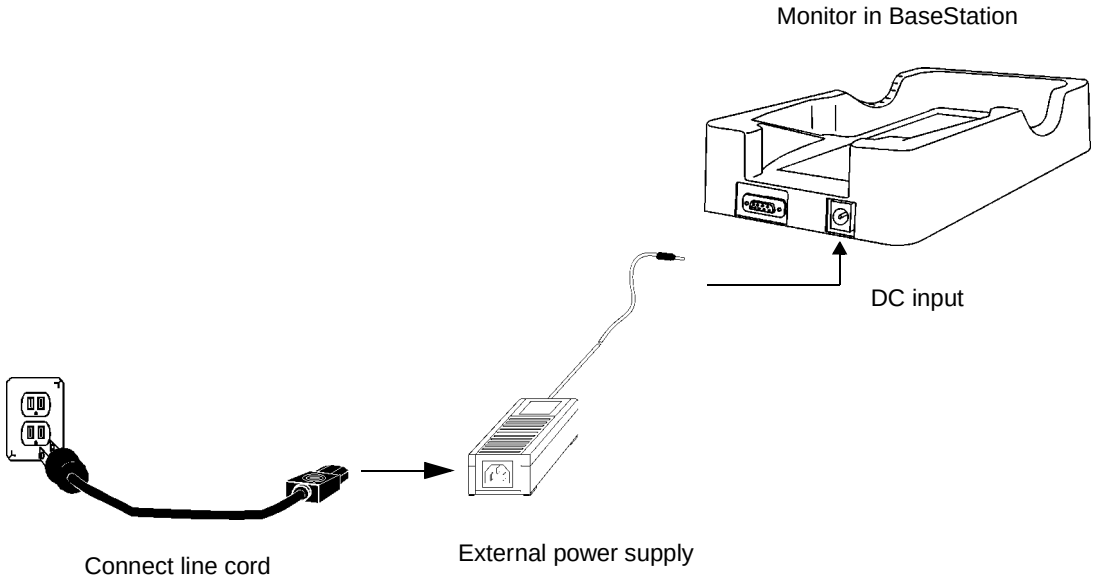
Input = Serial	Printing Columns = 40	Data Length = 8 bits
Printing Speed = High	User Font Back-up = ON	Data Parity = No
Auto Loading = ON	Character Select = Normal	Parity Condition = Odd
Auto LF = OFF	Zero = Normal	Busy Control = H/W Busy
Setting Command = Enable	International Character Set = U.S.A.	Baud Rate Select = 9600 bps
Printing Density = 100 %		

Information about the correct DIP switch settings can be found in the Seiko "DPU-414 Thermal Printer Operation Manual" included with your printer.

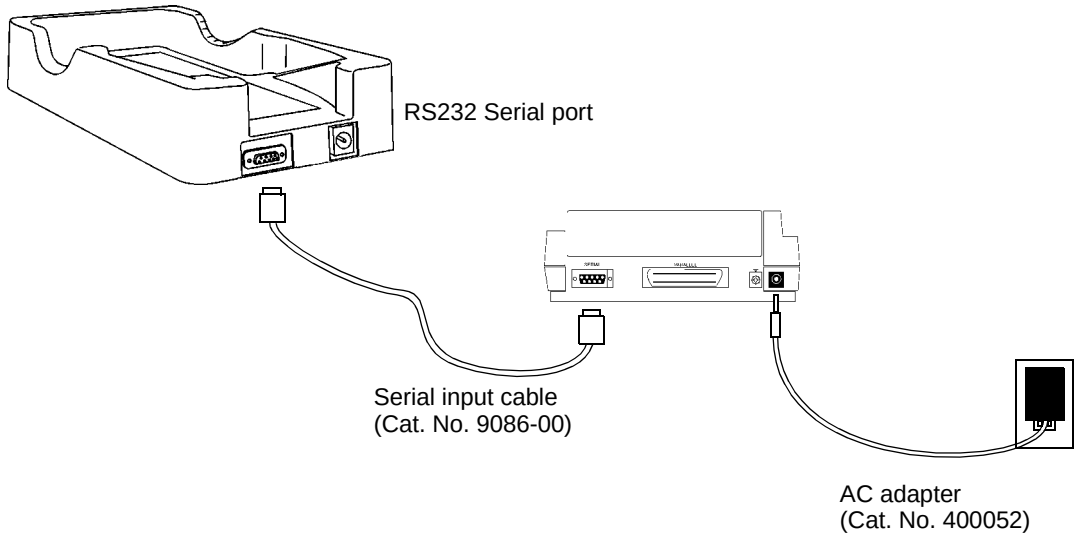
Connecting the Seiko DPU-414 Thermal Printer

To connect a Seiko DPU-414 Thermal Printer (PN: 9140-00) to the *TIDAL WAVE Sp*:

1. Connect the external power supply (PN: 9220-10) to an AC source using a hospital grade line cord. It is recommended that the monitor be powered by the BaseStation using the external power supply when printing. This will prevent power loss from a depleted battery.
2. Connect the external power supply's cable to the BaseStation's power input jack.



3. Connect the interface cable (PN: 9086-00) to the BaseStation's RS232 serial port, then to the Seiko printer's serial input connector—the 9 pin D connector.
4. Connect the Seiko's AC adapter to the printer then to an AC source. Turn the printer on; place the monitor in the BaseStation.



Interpreting Printer Output

Header

Each printout starts with a header that identifies the capnograph/oximeter (*TIDAL WAVE Sp*). The date and time of the printout is furnished by the monitor's calendar/clock. Space is then provided to enter patient information. The type of printout (Tabular, Trend) is then identified.

Trend Printout

To create a Trend Printout from the graphical or histogram trend display:

1. Ensure the printer is connected and ready to print.
2. Press and hold the Page key to display SELECT PRINT OPTIONS menu.
3. The arrow pointer will flash beside the currently selected option. Press the SELECT key to select TREND.
4. Press the EXIT key to exit and begin printing.
5. PRINTING IN PROGRESS appears. Press STOP to terminate printing.

   The printer stops automatically when the printout is complete.

Graphical Data

A graphical depiction of trend memory is printed after the header for all Trend printouts.

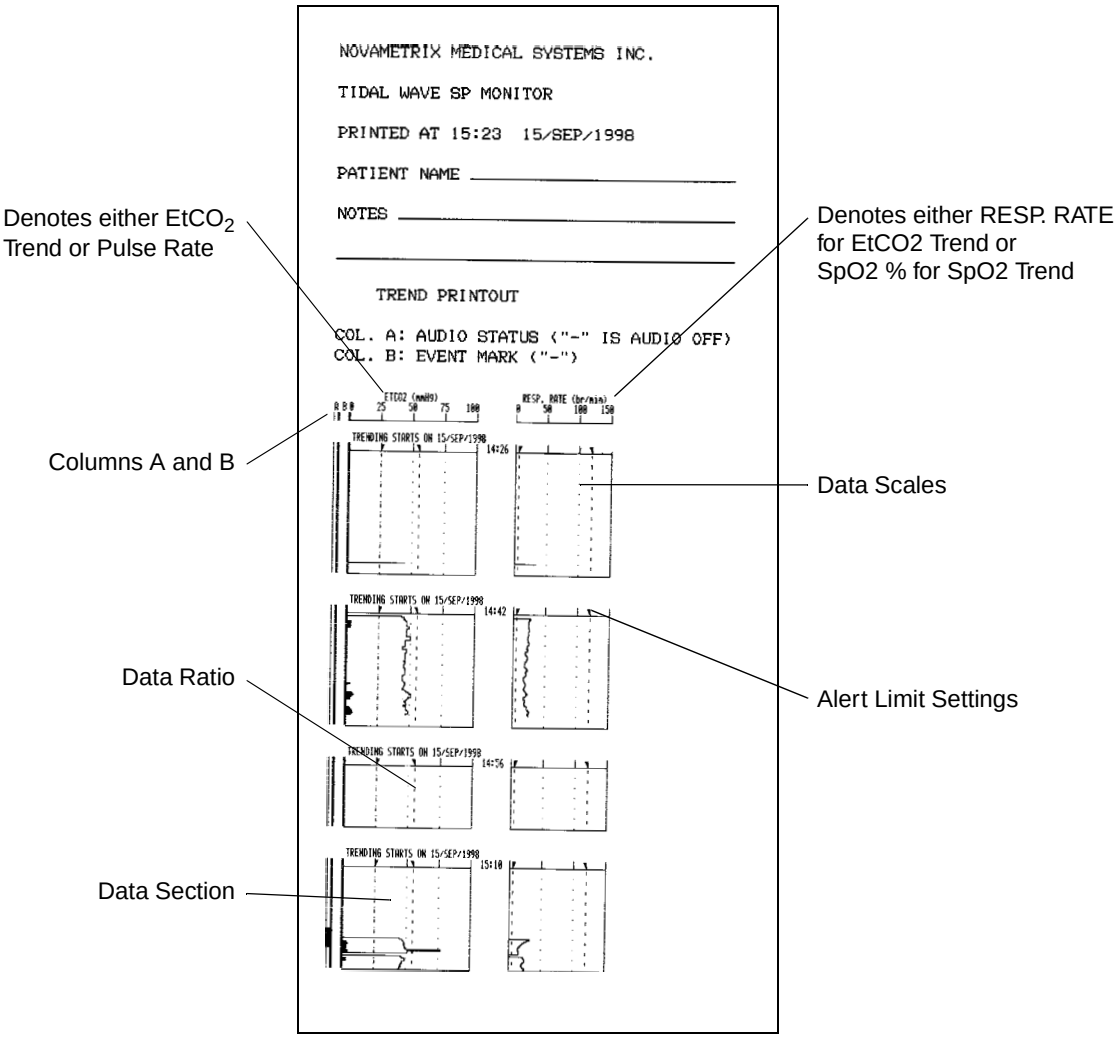
Column A and B Information: The next two lines refer to Columns A and B in the printout. Column A represents the monitor's audible alarm status. A mark (black bar) in this column indicates that the audible alarms were silenced during this portion of the printout. Column B shows marks where "Events" were added to trend memory.

Data Scales: The data scales are printed and dotted lines within the data section correspond to the major divisions shown on the scale lines.

Data Ratio: The line following the data scales shows the date the recording was initiated and the data ratio. The data compression ratio depends on the type of printout selected. For example, one dot on the printout may correspond to 8 or 64 seconds.

Alert Limit Settings: Following the data ratio and just before the actual data are the alert limit settings. Both the pulse rate and saturation scales have two triangle shaped markers that represent the upper and lower alert limit settings as shown on the monitor's display. Dashed lines extend from these markers down into the data section of the printout. If the alert limits were changed during the time the printed data was originally collected, the new alert limits will be printed with a message indicating that the limits were changed.

Data Section: The data is printed based on the ratio. A time stamp is placed at regular intervals and appears as a horizontal line printed between the scales.


NOVAMETRIX MEDICAL SYSTEMS INC.
TIDAL WAVE SP MONITOR
PRINTED AT 15:23 15/SEP/1998
PATIENT NAME
NOTES
TREND PRINTOUT
COL. A: AUDIO STATUS ("-" IS AUDIO OFF)
COL. B: EVENT MARK ("-")
Denotes either EtCO2 Trend or Pulse Rate
Denotes either RESP. RATE for EtCO2 Trend or SpO2 % for SpO2 Trend
Columns A and B
Data Scales
Data Ratio
Alert Limit Settings
Data Section

Histogram Data

A histogram based on the printed portion of trend memory is printed after the graphical data for all trend printouts.

Total Elapsed Time. Time trending was active; the total time covered by the printout.

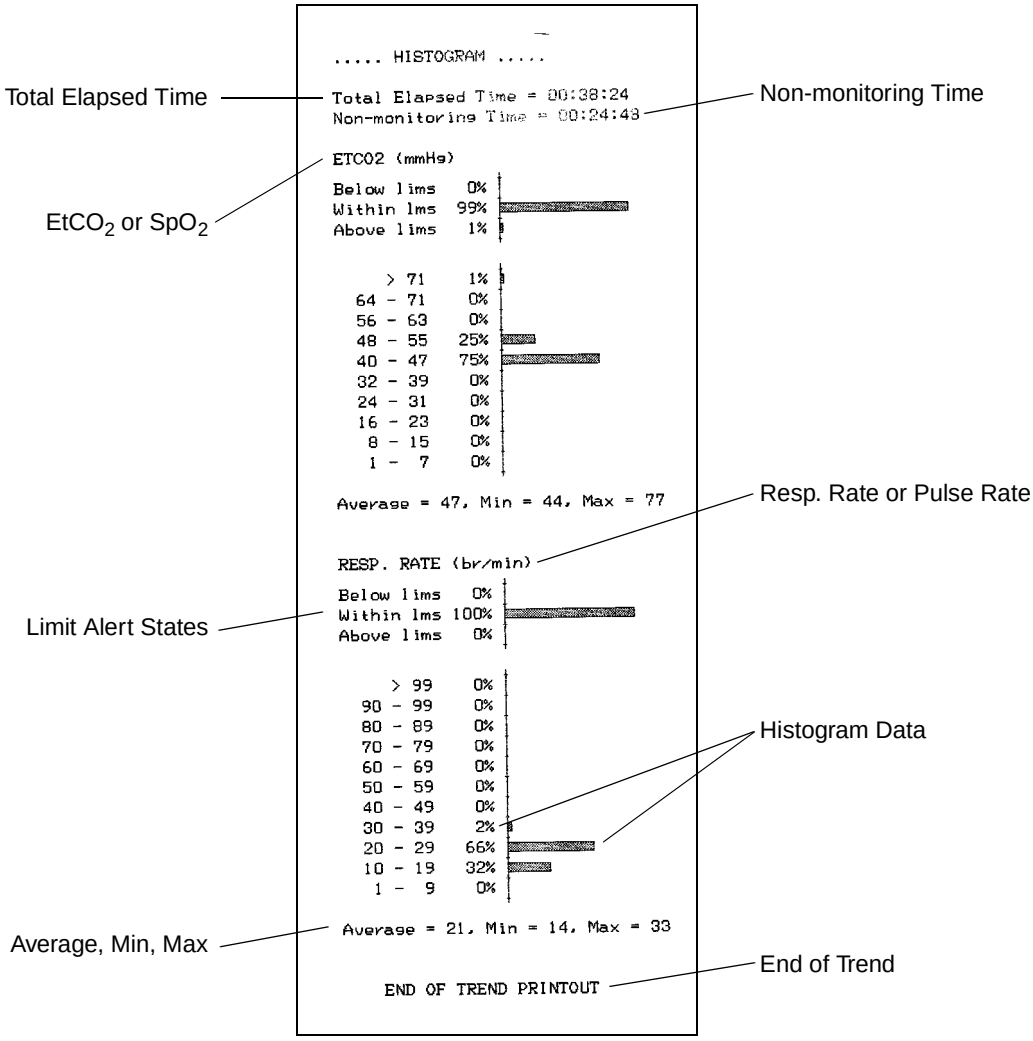
Non-Monitoring Time. Total time spent in a non-monitoring condition.

Limit Alert Status. Percent of monitoring time spent above, below and within the parameter alert limits as shown on the printout.

Histogram Data. A numerical and graphical display of the percentage of monitoring time (non-monitoring time excluded) spent in each of the ranges listed. Note that some time, but less than one percent of the total time, can be spent in any category.

Average, Min and Max. The minimum and maximum recorded parameter values are printed. Average refers to the most often recorded value and not the mathematical mean of all readings.

End of Trend Printout. Message shows Histogram is a part of the Print Trend feature.



Tabular Mode Text Printout

To start a Tabular Mode Printout:

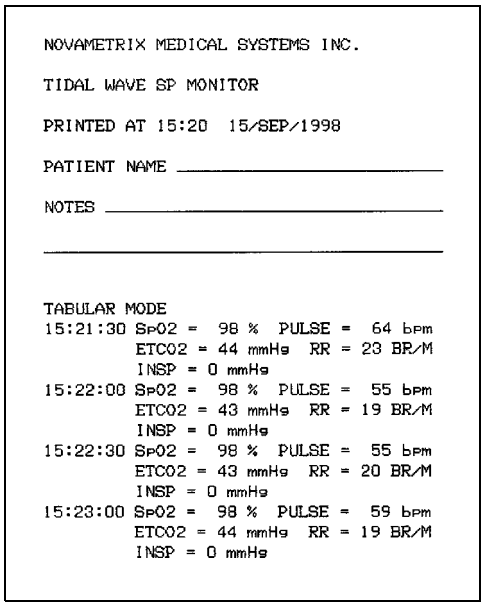
1. Ensure the printer is connected and ready to print.
2. Press and hold the Page key to display the Print Options screen.
3. The arrow pointer will flash beside the currently selected option. Press the SELECT key to select TABULAR.
4. Press the EXIT key to exit and begin printing.
5. PRINTING IN PROGRESS appears. Press STOP to terminate printing.

   The printer stops automatically when the printout is complete.

Tabular Data Format

Tabular Mode Text Printouts start off with a header (refer to previous section) followed by one section of text printed at 30 seconds intervals. This text includes oxygen saturation, pulse rate, $EtCO_2$, respiration rate, and inspired CO_2, in the units set in the monitor's Configuration menus.

The format of the tabular text line is "HH:MM:SS SPO2 = XXX % PULSE = YYY bpm", where HH:MM:SS is the hour, minute and seconds (24 hour format), XXX is the displayed saturation value, and YYY is the displayed pulse rate.


NOVAMETRIX MEDICAL SYSTEMS INC.
TIDAL WAVE SP MONITOR
PRINTED AT 15:20 15/SEP/1998
PATIENT NAME _____
NOTES _____
TABULAR MODE
15:21:30 SpO2 = 98 % PULSE = 64 bpm
ETCO2 = 44 mmHg RR = 23 BR/M
INSP = 0 mmHg
15:22:00 SpO2 = 98 % PULSE = 55 bpm
ETCO2 = 43 mmHg RR = 19 BR/M
INSP = 0 mmHg
15:22:30 SpO2 = 98 % PULSE = 55 bpm
ETCO2 = 43 mmHg RR = 20 BR/M
INSP = 0 mmHg
15:23:00 SpO2 = 98 % PULSE = 59 bpm
ETCO2 = 44 mmHg RR = 19 BR/M
INSP = 0 mmHg

Section 7 Maintenance

Cleaning and Sterilization

Follow the cleaning and sterilization instructions listed below to clean and/or sterilize the monitor and its accessories.

Monitor, BaseStation and External Power Supply

- Turn the monitor off, and unplug the BaseStation and the external power supply from the AC power source before cleaning.
- The monitor, BaseStation and external power supply can be cleaned and disinfected by wiping with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Wipe down with a water-dampened clean cloth to rinse. Dry before use.
- Do not immerse the monitor, BaseStation or external power supply.
- Do not attempt to sterilize the monitor, BaseStation or external power supply.

SpO_2 Finger Sensor

- The sensor can be cleaned and disinfected by wiping with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Then wipe down with a water dampened clean cloth to rinse. Dry before use.
- Make certain that the finger sensor windows are clean and dry before reuse.
- Do not immerse the finger sensor.
- Do not attempt to sterilize the finger sensor.
- After cleaning the finger sensor, verify that the sensor is physically intact, with no broken or frayed wires or damaged parts. Make certain that the connectors are clean and dry, with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated or corroded connectors.
- Perform a “Quick Check” to verify the integrity of the sensor (See “Finger Sensor Quick Check” on page 29).

SpO_2 Y-Sensor

- Do not immerse connector on the Y-Sensor.
- The Y-Sensor may be immersed—up to, but not including, the connector, in a 2% gluteraldehyde solution, or 10% bleach solution. Refer to manufacturer’s instructions and standard hospital protocols to determine recommended times for disinfection and sterilization.
- Rinse thoroughly with water and dry before use (do not rinse the connector).

- Do not attempt to sterilize Y-Sensor except as stated above.
- After cleaning or sterilizing the Y-Sensor, verify that the sensor is physically intact, with no broken or frayed wires or damaged parts. Make certain that the connectors are clean and dry, with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated, or corroded connectors.
- Perform a "Quick Check" to verify the integrity of the sensor (See "Y-Sensor Quick Check" on page 36).

SpO_2 Y-Strip Tapes and Foam Wraps

- Treat Y-Strip Tapes and foam wraps in accordance with hospital protocol for single-patient use items.

Ear Clip

- Do not immerse the ear clip
- Clean the ear clip with a cloth dampened with 70% isopropyl alcohol. After cleaning wipe the ear clip down thoroughly with a clean water dampened cloth to rinse.

CAPNOSTAT CO_2 Sensor

- Clean the sensor surface with a damp cloth.
- Make certain that the sensor windows are clean and dry.
- Do not immerse the CAPNOSTAT CO_2 sensor.
- Do not attempt to sterilize the CAPNOSTAT CO_2 sensor.

Single Patient Use Airway Adapters

- Treat all single patient use airway adapters in accordance with hospital protocol for single-patient use items.

External Sampling System Components (Model 715)

- The Nasal Sampling Cannulas and adapters are for single-patient use.

Internal Sampling System Components (Model 715)

Acceptable fluids for cleaning and sterilizing the internal pneumatic parts of the Sampling System include isopropyl alcohol, Cidex® or equivalent, or a 5.25% water solution by weight of sodium hypochlorite (bleach).

CAUTION

Do not attempt to pump cleaning/sterilizing liquid with the sampling pump. This may cause accelerated wear on the pump bearings. Always flush liquids with a syringe as described in the following instructions.

To clean and disinfect the pumping system:

1. Turn the monitor off and disconnect the external power supply (if connected).
2. Remove both the sampling inlet tubing set and the sampling exhaust tubing (if any).
3. Attach an exhaust port line (1/8 inch or 3/16 inch I.D. tubing) from the Sampling Exhaust GAS port to a suitable container located below the bottom level of the monitor.
4. Use a 60 cc catheter tip syringe. Fit it to the Sampling Inlet GAS connector. Flush the sterilizing solution slowly through the pumping system. Push the entire 60 cc of solution through the Sampling Inlet GAS. Repeat this process two more times to use a total of 180 cc of solution.
5. Remove the syringe and leave the cleaning/sterilizing fluid within the sampling pump system for 30 minutes to disinfect the system. Follow sterilant manufacturer's instructions for disinfection.
6. After 30 minutes, fill the syringe with distilled water and flush the system three times. Allow the cleaning/disinfection solution and distilled water to drain through the Sampling Exhaust GAS output.
7. Push several syringes of air slowly through the system to ensure that most of the liquid has been drained.
8. Follow this with at least three more syringes of distilled water, followed by at least two more syringes of air to make sure that most of the distilled water has been drained.
9. Remove the syringe from the unit. Do not connect the sampling inlet tubing. Connect the external power supply and turn the monitor on. Allow the sampling pump to operate for several minutes. This will help to remove any trapped water.
10. Connect a sampling tubing set to the Sampling Inlet GAS.
11. Block the open end of the tubing with your finger. Alternate blocking and unblocking the tubing end at least ten times. Use a quick, brisk motion when blocking and unblocking the tubing. Keep the tubing blocked and unblocked for several seconds at a time.
12. Repeat the same blocking and unblocking action with your finger on the sampling exhaust GAS port.
13. Allow the sampling system to run for at least 30 minutes without the sampling assembly tubing and the sampling exhaust tubing connected. This will speed dry the system pneumatics.
14. Once these cleaning and disinfection instructions have been completed, normal sampling system operation can be resumed. See "Sidestream Sampling (Model 715)" on page 25 for more information.

Battery Maintenance

If the monitor has not been used or powered by the external power supply for an extended time* (3 months or more) allow the battery to charge before use or replace the battery with a fully charged battery and

continue monitoring. The monitor may not power up on battery power if the battery is not sufficiently charged. Refer to “Battery Life and Recharge Times” on page 14 for charging times and instructions.

Maintenance Schedules

When the monitor powers up, a self-test is performed which checks the internal electronics of the monitor. If this self-test fails, remove the monitor from use and contact qualified service personnel.

The monitor should undergo routine inspection and safety checks on a quarterly basis or according to hospital protocol. The *TIDAL WAVE Sp* Service Manual (Catalog No. 9110-90/9146-90) contains procedures and safety test instructions, component parts lists, circuit diagrams, theory of operation and other information to assist qualified service personnel in servicing the monitor.

*. The internal battery will slowly discharge over long periods of non-use.

Section 8 *Specifications*

General

Specifications for the Novametrix *TIDAL WAVE Sp* Monitor, Model 710/715, are listed for informational purposes only, and are subject to change without notice.

Capnograph

- Principle of Operation: Non-Dispersive Infrared (NDIR) absorption, dual wavelength ratiometric-single beam optics
- Sensor Type: "Mainstream" (no gas sample drawn from breathing circuit)
- Initialization Time: Capnogram in 15 seconds, full specifications in 60 seconds.
- Response Time: 60 ms
- Gas Compensation - Room Air, O_2 > 60%, N_20 > 60%: Operator selectable in configuration screen.
- Barometric Pressure Compensation: Automatic (range 400-800 mmHg)
- CAPNOSTAT CO_2 Sensor and Airway Adapter:
  Weight: Less than 18 g without cable
  Sensor Size: 1.3 x 1.67 x .85 inches (3.30 x 4.24 x 2.16 cm), 6 foot cable (1.83 m)
  Construction: Durable high performance plastic, ultra-flexible cable
  Shock Resistant: CAPNOSTAT CO_2 sensor withstands a 6 foot drop to a tile floor
- Airway Adapter: Single Patient Use, less than 5 cc deadspace, meets ANSI Z-79

$EtCO_2$ Section (Mainstream)

- Range 0-150 mmHg, CO_2 partial pressure
- Accuracy*: 0-40 mmHg ±2 mmHg, 41-70 mmHg 5% of reading, 70-150 mmHg ±8% of reading.
- Warm-up Time: Operational in 15 seconds, 1 minute to full specifications
- Step Response Time: 60 ms, adult; less than 50 ms, neonate
- Averaging Time: 1 breath, 10 seconds (default), 20 seconds, instantaneous
- Display Resolution: 0-25, 0-50, and 0-150 mmHg in 31 pixels
- Alerts: The Model 710 has user selectable alert limits for $EtCO_2$.

*Allows for halogenated anesthetic agents which may be present at normal clinical levels. The presence of desfluane in the exhaled breath beyond normal levels (5-6%) may positively bias Carbon Dioxide values by up to an additional 2-3 mmHg.

Respiratory Rate (Mainstream)

- Range 0-150 breaths/min.
- Accuracy: ±1 breaths/min.
- Alerts: The Model 710/715 has user selectable alert limits for Respiratory Rate.
- Averaging Time: 8 seconds

$EtCO_2$ Section (Sidestream)

- Range 0-150 mmHg, CO_2 partial pressure
- Accuracy: 0-40 mmHg ±2 mmHg, 41-70 mmHg 5% of reading, 70-150 mmHg ±8% of reading.
- Warm-up Time: Operational in 15 seconds, 1 minute to full specifications
- Step Response Time: less than 200 ms; Sampling Rate - 180 cc/min.
- Averaging Time: 1 breath, 10 seconds (default), 20 seconds, instantaneous
- Display Resolution: 0-25, 0-50, and 0-150 mmHg in 31 pixels
- Alerts: The Model 715 has user selectable alert limits for $EtCO_2$.

Respiratory Rate (Sidestream, Model 715)

- Range 0-70 breaths/min
- Accuracy: ±1 breaths/min.
- Alerts: The Model 715 has user selectable alert limits for Respiratory Rate.
- Averaging Time: 8 seconds

SpO_2 Section

- Range 0-100%
- Accuracy: ±2% SpO_2 (for 80-100% SpO_2), (1 standard deviation or 68% of readings within claim) unspecified for 0-79% SpO_2
- Display Resolution: 1%
- Averaging Time: menu-selectable times of 2 and 8 seconds (default is 8 seconds)
- Audible SpO_2 Trend Feature: Pitch of (user selectable) pulse rate “beep” tracks the SpO_2 values (i.e. decreasing SpO_2 values are signaled by lower pitched “beeps”).
- Settling Time: Display settles to within 1% of final reading less than 15 seconds after the sensor is properly applied.
- Alerts: The Model 710/715 will have user selectable alert limits for SpO_2.

Pulse Rate Section

- Range: 30-250 beats per minute (bpm)
- Accuracy: (1 standard deviation), 1% of full scale
- Display Resolution: 1 bpm
- Averaging Time: menu-selectable times of 2 and 8 seconds (default is 8 seconds)
- Settling Time: Display settles to within 1% of final reading less than 15 seconds after the sensor is properly applied.

- Alerts: The Model 710/715 will have user selectable alert limits for Pulse Rate.

Monitor Specifications

- Classification (IEC601-1): Class II/internal power source, type BF, enclosure protection rating of IPX1**. Operating Environment: 50 to 104° F (10 to 40° C), 0-90% relative humidity (non-condensing)
- Transport/Storage:
  short term: 14° to 122° F (-10 to 50° C) with NiMH battery
  long term: 14° to 95° F (-10 to 35° C) with NiMH battery
  storage: 14° to 131° F (-10° to 55° C) without NiMH battery
- Size: 7.9" x 3.25" x 1.5"
- Weight: 24 ounces
- Power: 100-250 VAC, .38A, 50-60 Hz
- Battery: Rechargeable NiMH battery pack (Cat. No. 400043) or equivalent; AA lithium batteries - Energizer L91 or equivalent.
- Battery Life: Approximately 4.5 hours of continuous use with fully charged NiMH rechargeable battery pack. Approximately 4.0 hours with sample pump in operation.
- Display: LED backlit 2.5" x 1.25" LCD, adjustable contrast
- LED indicators for: Low battery, adapter type, audio/alert status (indicates audio off, 2 minute silence, active alert), and external power.
- Electromagnetic Emissions: Conforms to EMC Directive 89/336/EEC, CISPR Class A. Tested to EN55011 (1991) and CISPR11 (1990).
- Electromagnetic Immunity: Conforms to EMC Directive 89/336/EEC, EN50082-1 (1992). Tested to IEC801-3 (1984) Radiated Immunity. Conforms to Medical Device Directive 93/42/EEC and EN60601-1-2 (1993). Tested to IEC801-2 (1991) ESD, IEC801-4 (1988) EFT, and IEC1000-4-5 (1995) Surge Immunity.

Additional Features

- Audible SpO_2 Trend Feature: Pitch of Pulse Rate "beep" tracks the SpO_2 value, user selectable volume.
- Alert Limits: Automatic or menu selected high and low limits for $ETCO_2$, Respiratory Rate, SpO_2 and Pulse Rate. NO RESPIRATION alert selectable between 20, 40 and 60 seconds. Visible and audible alerts are immediate.
- 2-Minute Silence: When key is pressed, audible alerts are deactivated for two minutes. Indicated by yellow 2 minute LED and flashing bell icon
- Audio Off: Press and hold key for 3 seconds to deactivate audible alerts. Indicated by flashing yellow Audio Off LED and flashing bell icon.
- Trend Memory: 24 hour trend memory capacity, battery backed. On-screen 30 minute trends for $ETCO_2$, Respiration Rate and SpO_2. Other parameters are stored internally and can be downloaded to a PC.
- Digital Data Output: Serial (RS232), connect only to Novametrix approved devices.
- Sampling System (Model 715): Standard. Allows gas sampling of non-intubated patients
- Internal Battery-backed Real Time Clock

**External power supply excluded.

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Section 9 *Accessories*

TIDAL WAVE Sp (Model 710/715) Capnography/Oximetry Monitor

Catalog No.	Description
9110-00	*TIDAL WAVE Sp* **Handheld Mainstream Capnograph with Pulse Oximetry (Model 710)** includes Single Patient Use Adult Airway Adapter (6063-01), Carrying Case (315127) and choice of oximetry sensor: Finger (9168-00) or Y-sensor (9169-00).
9146-00	*TIDAL WAVE Sp* **Handheld Mainstream Capnograph with Pulse Oximetry and Sidestream Sampling (Model 715)** includes Single Patient Use Adult Airway Adapter (6063-01), Carrying Case (315127), choice of oximetry sensor: Finger (9168-00) or Y-sensor (9169-00), and Single Patient Use Sampling Adapter with Adult Nasal CO_2 Sampling Cannula (8955-01).

CO_2 AIRWAY ADAPTERS and ACCESSORIES

For monitoring CO_2 with the CAPNOSTAT CO_2 sensor.

6063-00	**Pediatric/Adult Single Patient Use Airway Adapters** (10 per box)
6063-25	**Pediatric/Adult Single Patient Use Airway Adapters** (25 per box)
6421-00	**Pediatric/Adult Single Patient Use Airway Adapters with mouthpiece** (10 per box)
6421-25	**Pediatric/Adult Single Patient Use Airway Adapters with mouthpiece** (25 per box)
6312-00	**Neonatal/Pediatric Single Patient Use Airway Adapters** (10 per box)
6312-25	**Neonatal/Pediatric Single Patient Use Airway Adapters** (25 per box)
8751-00	**CAPNOSTAT CO_2 Sensor Cable Holding Clips** (50 per box)

SAMPLING ADAPTERS and ACCESSORIES

8954-00	**Single Patient Use Sampling Adapters** (10 per box)
8954-25	**Single Patient Use Sampling Adapters** (25 per box)
8955-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Adult** (10 per box)
8955-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Adult** (25 per box)
8956-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Pediatric** (10 per box)
8956-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Pediatric** (25 per box)
8957-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Adult** (10 per box)
8957-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Adult** (25 per box)
8958-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Pediatric** (10/box)
8958-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Pediatric** (25/box)
8908-00	**Nafion® Dehumidification Tubing** (10 per box)

SpO_2 SENSORS and ACCESSORIES

Reusable DB-9 SpO_2 SENSORS

9168-00	**SuperBright Finger Sensor with DB-9 connector**, 3 ft.
9169-00	**SuperBright Y-Sensor with DB-9 connector**, 3 ft.

Catalog No.	Description
	SINGLE PATIENT USE SpO_2 SENSORS AND CABLES
6455-00	**Pediatric/Adult Single Patient Use SpO_2 Sensor** Terminates in DB-9 connector (10 per box)
6455-25	**Pediatric/Adult Single Patient Use SpO_2 Sensor** Terminates in DB-9 connector (25 per box)
6480-00	**Neonatal/Pediatric Single Patient Use SpO_2 Sensor** Terminates in DB-9 connector (10 per box)
6480-25	**Neonatal/Pediatric Single Patient Use SpO_2 Sensor** Terminates in DB-9 connector (25 per box)
	Y-STRIP TAPES, FOAM WRAPS and EAR CLIPS (for use with the Y-Sensor)
8828-00	**20mm Wrap Style Y-Strip Taping System** (100 per box) Use on neonatal foot and hand, or on pediatric toe or finger 20mm tapes use Blue color coded liners
8829-00	**25mm Wrap Style Y-Strip Taping System** (100 per box) Use on neonatal foot and hand 25mm tapes use Green color coded liners
8831-00	**20mm Finger Style Y-Strip Taping System** (100 per box) Use on pediatric finger or on small adult finger 20mm tapes use Blue color coded liners
8832-00	**25mm Finger Style Y-Strip Taping System** (100 per box) Use on adult finger 25mm tapes use Green color coded liners
8836-00	**Non-Adhesive Foam Wraps** (25 per box) For use with Y-Sensor
8943-00	**Neonatal/Pediatric Non-Adhesive Foam Wraps** (25 per box)) For use with Y-Sensor
6929-00	**Adhesive Foam Wraps** (25 per box) For use with Y-Sensor
6968-00	**Neonatal/ Pediatric Adhesive Foam Wraps** (25 per box) For use with Y-Sensor
6131-50	**Ear Clips** For use with Y-Sensor (5 per box)
6131-25	**Ear Clips** For use with Y-Sensor (25 per box)
8700	**Adhesive Dots** (250 per box)
	EXTENSION CABLES FOR SpO_2 SENSORS
9174-00	**4.5 Foot Extension Cable**, DB-9 to DB-9 Receptacle
9175-00	**4.5 Foot Extension Cable**, DB-9 to OxySnap
9180-00	**6 Inch Adapter Cable**, DB-9 to Hypertronics Receptacle

POWER SUPPLY OPTIONS

6998-00	**BaseStation** (External Power Supply and/or computer cable not included)
9220-10	**External DC Power Supply** (power cord not included)
6862-00	**AA Lithium Battery Pack** (requires 7 batteries)
400050	**AA Lithium Battery** (7 required)
400043	**NiMH Rechargeable Battery**
400049	**Battery Charger**, w/ AC Adapter, Universal Input Voltage, for type DR30 NiMH battery. Power cord included.

Catalog No.	Description

MISCELLANEOUS

140084	**Pole/shelf mount kit**
315127	**Transport Pouch**
6065-00	***NovaCARD for Windows***, Data Archive Software (3½" diskette)
600026	**Power Cord** (N. America only)
600075	**Cable**, BaseStation to Personal Computer (with 9-pin connector)
9086-00	**Cable**, BaseStation to Seiko DPU-414 Printer
9140-00	**Seiko DPU-414 Thermal Printer** w/Battery
400052	**AC Adapter for Seiko DPU-414 Printer**, 120 VAC
300017	**Thermal Printing Paper**, Seiko DPU-414 (5 rolls per box)
6081-00	**Gas regulator**, for use with precision gas mixture, Cat. No. 8364-10
8364-10	**Precision gas mixture** for validation
9110/9146-90	**Service Manual,** *TIDAL WAVE Sp* (Model 710/715) Handheld Capnograph/Oximetry Monitor

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Section 10 *Warranty*

Equipment manufactured or distributed by Novametrix Medical Systems Inc., is fully guaranteed, covering materials and workmanship, for a period of one year from the date of shipment, except for certain disposable products and products with stated guarantees other than one year. Novametrix reserves the right to perform guarantee service(s) at its factory, at an authorized repair station, or at the customer's installation.

Novametrix' obligations under this guarantee are limited to repairs, or at Novametrix' option, replacement of any defective parts of our equipment, except fuses, batteries, and calibration gasses, without charge, if said defects occur during normal service.

Claims for damages during shipment must be filed promptly with the transportation company. All correspondence concerning the equipment must specify both the model name and number, and the serial number as it appears on the equipment.

Improper use, mishandling, tampering with, or operation of the equipment without following specific operating instructions will void this guarantee and release Novametrix from any further guarantee obligations.

Service Department
For factory repair service, call toll free
1-800-243-3444
In Connecticut, call Collect (203) 265-7701
Facsimile (203) 284-0753
World Wide Web: http://www.novametrix.com
Internet: techline@novametrix.com

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Service Policy

Novametrix Medical Systems Inc. provides 24-hour a day access to technical support through its Technical Support Department in Wallingford, Connecticut, and company Service Representatives located throughout the United States. (Outside the U.S., primary technical support is handled through our qualified international sales and service distributors.)

Novametrix will provide Warranty Service support within 48 hours of receiving a request for assistance. Contact the Technical Support Department by telephone toll free at 800-243-3444, or 203-265-7701; by facsimile at 203-284-0753; or, by e-mail at techline@novametrix.com. After hours telephone support requests (before 8:00 AM and after 5:00 PM Eastern Time) will be responded to promptly by the Technical Support on-call staff. After hours facsimile and e-mail requests will be answered the next business day. It is suggested that any person calling in for technical support have the equipment available for product identification and preliminary troubleshooting.

Novametrix reserves the right to repair or replace any product found to be defective during the warranty period. Repair may be provided in the form of replacement exchange parts or accessories, on-site technical repair assistance or complete system exchanges. Repairs provided due to product abuse or misuse will be considered “non-warranty” and invoiced at the prevailing service rate. Replaced or exchanged materials are expected to be returned to Novametrix within 10 days in order to avoid (additional) charges. Return materials should be cleaned as necessary and sent directly to Novametrix using the return paperwork and shipping label(s) provided (Transferring return materials to a local sales or dealer representatives does not absolve you of your return responsibility.).

Novametrix manufactures equipment that is generally field serviceable. When repair parts are provided, the recipient can call Technical Support for parts replacement assistance and repair assurance. In the event a replacement part requires increased technical capability, Technical Support may request Biomedical assistance, provide on-site technical support or complete replacement equipment. If the customer requires the return of their original product, the exchange material will be considered “loaner material” and exchanged again after the customer equipment is repaired.

Novametrix promotes customer participation in warranty repairs, should they become necessary. A longer useful product life, and quicker, more cost-effective maintenance and repair cycles—both during and after the warranty period, are benefits of a smooth transition into self-maintenance. The Technical Support Department can provide technical product support at a level appropriate to your protocol and budget requirements.

Please contact Technical Support for information on these additional programs and services:

- Focus Series Technical Training Seminars
- Test Equipment and Test Kits
- Service Contract / Parts Insurance Plans
- On-Site Technical Support
- “Demand Services” including:
  - Flat rate parts exchange
  - Flat rate return for repair
  - Time and material,
  - Full warranty, discounted replacement sensors.